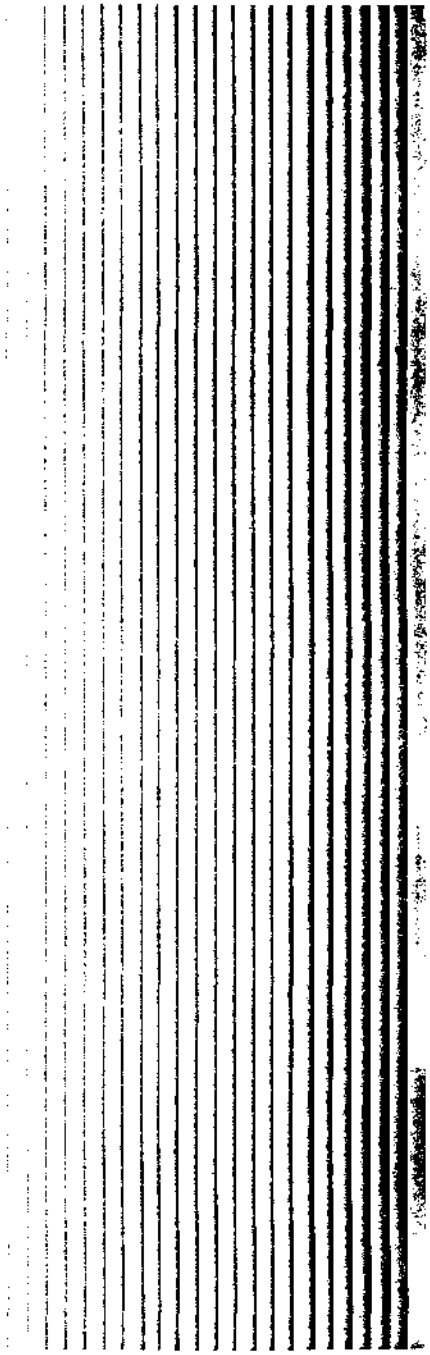




# WY-30 Maintenance Manual

WYSE

## OVERVIEW

This maintenance manual contains information on how to service and repair the WY-30 terminal. We assume you are a qualified service technician with previous experience in terminal and computer repair. To take full advantage of this manual, we suggest you read the information in the order presented.

## HOW TO USE THIS MANUAL

This manual is divided into seven chapters and four appendixes. Chapter one provides important information for the technician who has never serviced this terminal before. If you are already familiar with the terminal, the technical information in Appendix A can remind you about the terminal.

Here is a summary of this manual:

**Chapter 1, "General Information,"** describes the terminal, including information about internal functions, input/output (I/O), telecommunications, environmental needs, and operator controls.

**Chapter 2, "Removal and Replacement Procedures,"** shows you how to take the terminal apart and put it back together again.

**Chapter 3, "Troubleshooting,"** tells you what to look for and how to fix problems with the terminal. It includes a list of tools needed for troubleshooting, a quick reference guide, and a flowchart.

**Chapter 4, "Adjustments and Alignments,"** describes power supply and monitor adjustments that control the quality of the display.

**Chapter 5, "Illustrated Parts List,"** includes a list of display and keyboard assembly parts.

**Chapter 6, "Theory of Operation,"** describes the terminal operation by function.

**Chapter 7, "Schematics,"** contains schematic representations of all the terminal's circuits.

**Appendix A, "Specifications,"** lists the terminal's specifications.

**Appendix B, "Connector Pin Assignments,"** lists the signals on each pin of the MODEM and the AUX ports located on the rear panel of the terminal.

**Appendix C, "Test Connectors,"** describes how to make diagnostic hood test connectors.

**Appendix D, "Display Inspection With the Reticle,"** describes how to check the terminal's display with a special tool, the reticle.

## REFERENCE MANUALS

The following publications provide additional information about the terminal:

WY-30 User's Guide, Document 880093-01

WY-30 Programmer's Guide, Document 880093-02

TABLE OF CONTENTS


OVERVIEW ..... iii

1 GENERAL INFORMATION

Introduction ..... 1-2
High Level Functional Description ..... 1-2
Microcomputer ..... 1-2
Memory ..... 1-2
Terminal Control ..... 1-2
Input/Output Devices ..... 1-2
Environment ..... 1-4
Operator Interfaces ..... 1-5
Setup Parameters ..... 1-6
Cleaning ..... 1-7

2 REMOVAL AND REPLACEMENT PROCEDURES

Overview ..... 2-2
Before You Start ..... 2-2
Removing and Replacing Assemblies in the Keyboard Module ..... 2-3
Removing and Replacing Assemblies in the Terminal Module ..... 2-5

3 TROUBLESHOOTING

Before You Start ..... 3-2
Troubleshooting Quick Reference Guide ..... 3-3
Troubleshooting Flowchart ..... 3-3
Troubleshooting Aids ..... 3-8

4 ADJUSTMENTS AND ALIGNMENTS

Before You Start ..... 4-2
Power Adjustments ..... 4-3
Does the Terminal Meet the Display Specifications? ..... 4-4
Aligning the Terminal Display ..... 4-6
Adjustments ..... 4-7

## 5 ILLUSTRATED PARTS LIST


Introduction ..... 5-2
Terminal Display Assembly Exploded View ..... 5-3
Keyboard Assembly Exploded View ..... 5-4
Terminal Components List ..... 5-5
Keyboard Components List ..... 5-8
Terminal Board Assembly Layout ..... 5-9


## 6 THEORY OF OPERATION


Introduction ..... 6-2
Microcomputer and Related Logic ..... 6-2
Power Supply and Monitor Circuitry ..... 6-10
Keyboard ..... 6-13
Communication Ports ..... 6-13
Terms and Abbreviations ..... 6-13


## 7 SCHEMATICS


Keyboard PCB ..... 7-3
Terminal PCB (Logic) ..... 7-5
Terminal PCB (Monitor/Power Supply) ..... 7-7


## APPENDIXES


A Specifications ..... A-1
B Connector Pin Assignments ..... B-1
C Test Connectors ..... C-1
D Display Inspection with the Reticle ..... D-1

**INDEX** ..... I-1


## LIST OF FIGURES


1-1 Keyboard ..... 1-3
1-2 Terminal Dimensions ..... 1-4
1-3 Operator Interfaces ..... 1-5
2-1 Terminal Modules ..... 2-2
2-2 Keyboard Assembly ..... 2-4
2-3 Removing the Terminal Enclosure ..... 2-6
2-4 Replacing the Fuse ..... 2-7
2-5 Removing the Terminal PCB ..... 2-9
2-6 Removing the CRT/Yoke Assembly ..... 2-11
2-7 Replacing the Yoke ..... 2-12
2-8 Discharging the Anode Before Removal ..... 2-13
2-9 Discharging the Anode Before Installation ..... 2-14
3-1 Troubleshooting Flowchart ..... 3-4

## LIST OF FIGURES Continued


4-1 Power Supply Component Layout ..... 4-3
4-2 Adjustment Locations ..... 4-8
4-3 Yoke Lock on the CRT Neck ..... 4-10
4-4 Display Magnets ..... 4-11
4-5 Centering Rings ..... 4-12
5-1 Terminal Display Assembly Exploded View ..... 5-3
5-2 Keyboard Assembly Exploded View ..... 5-4
5-3 Terminal Board Assembly Layout ..... 5-9
6-1 Memory Map ..... 6-3
7-1 Keyboard PCB Schematic ..... 7-3
7-2 Terminal PCB Schematic (Logic) ..... 7-5
7-3 Terminal PCB Schematic (Monitor/Power Supply) ..... 7-7
D-1 Video Inspection Reticle ..... D-1
D-2 Checking Width and Height ..... D-3
D-3 Checking Straightness, Pincushioning, Centering, and Vertical Linearity ..... D-4


## LIST OF TABLES


3-1 Troubleshooting Quick Reference Guide ..... 3-3
3-2 Terminal Installation Checklist ..... 3-8
3-3 Power-On Self-Test Error Messages ..... 3-11
3-4 Diagnostic Self-Test Error Messages ..... 3-12
3-5 Terminal PCB Circuit Isolation Jumpers ..... 3-13
4-1 Display Problems and Adjustments ..... 4-7
4-2 Screen Areas Affected by Display Magnets ..... 4-11
5-1 Terminal PCB Components List ..... 5-5
5-2 Keyboard Components List ..... 5-8
5-3 Diagnostic Self-Test Connectors ..... 5-11
6-1 6800 Interrupt Sources ..... 6-3
6-2 Values Loaded into CRTC ..... 6-7
6-3 Screen Attribute Assignments ..... 6-8
B-1 MODEM Port Pin Assignments (DTE) ..... B-1
B-2 AUX Port Pin Assignments (DTE) ..... B-1

# 1 GENERAL INFORMATION


**Introduction** ..... 1-2

**High Level Functional Description** ..... 1-2

**Microcomputer** ..... 1-2

**Memory** ..... 1-2

**Terminal Control** ..... 1-2

**Input/Output Devices** ..... 1-2
- CRT Display ..... 1-3
- Communications Interfaces ..... 1-3
- Keyboard ..... 1-3

**Environment** ..... 1-4

**Operator Interfaces** ..... 1-5
- Keyboard ..... 1-5
- Power Cord ..... 1-6
- Communications Cable ..... 1-6
- AC Power Switch ..... 1-6
- Brightness Slideswitch ..... 1-6
- Touch/Tilt Screen Adjustment ..... 1-6

**Setup Parameters** ..... 1-6

**Cleaning** ..... 1-7

## INTRODUCTION

The WY-30 is a low-cost, entry-level, ASCII display terminal. It consists of a display console and a detachable keyboard. A user enters information for display from the keyboard. The terminal contains all of the electronics that support the display and keyboard.

In addition to the cathode ray tube (CRT) and keyboard, the WY-30 contains two independent communications interfaces. Peripherals, including a hard-copy printer or plotter, can be attached to the terminal with interface connectors on the rear panel.

The component parts are organized around and controlled by the microprocessor. The microprocessor controls all internal data manipulation and processing functions.

## HIGH LEVEL FUNCTIONAL DESCRIPTION

The terminal consists of a microprocessor and related logic, a CRT controller and associated control logic, input/output (I/O) devices, monitor and power supply circuitry, and a CRT. All circuitry is mounted on a single printed circuit board (PCB), the terminal PCB. The microprocessor controls all basic functions.

## MICROCOMPUTER

The microcomputer comprises a clock and synchronization circuit, program memory, 4K of RAM, a reset circuit, and the heart of the terminal--a 2-megahertz, 6800-family microprocessor--the 68B00.

## MEMORY

Terminal memory consists of RAM and ROM. The microprocessor uses 4K of RAM for buffers, variable storage and system stack. The video interface shares this RAM for screen refresh. Program memory, 8K of ROM, holds all the terminal control firmware.

## TERMINAL CONTROL

Functions of the terminal control firmware include keyboard scanning, video control, data transfer to and from the communication ports, and on-screen data manipulation.

## INPUT/OUTPUT DEVICES

I/O devices consist of a CRT display, two communications interfaces, and a keyboard.

## CRT Display

The terminal has a 14-inch, flat-screen CRT. It displays 24 rows of characters, 80 columns, and two control rows (one for terminal status and the other for label, message, and setup). The CRT controller reads displayed characters from RAM on a direct memory access (DMA) basis.

## Communications Interfaces

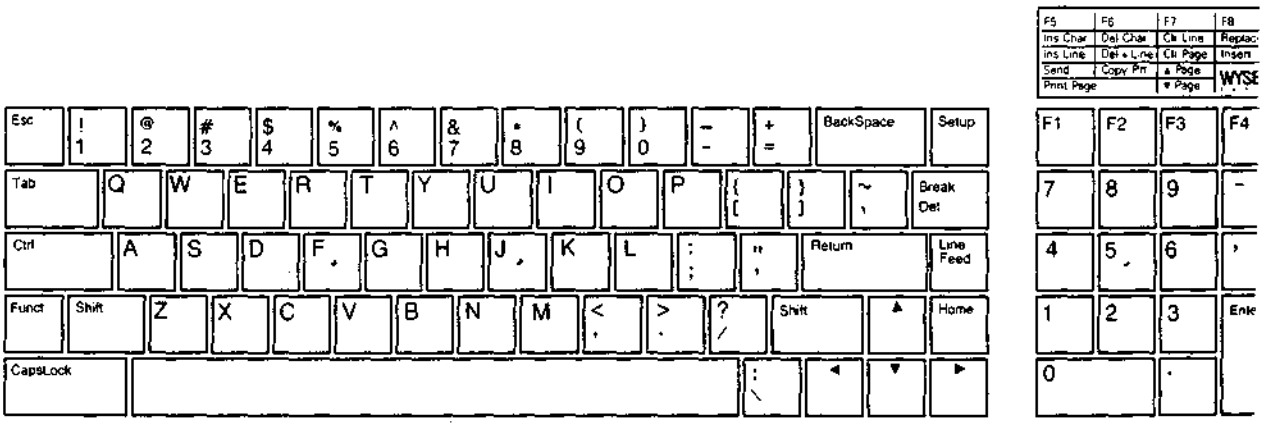
The terminal has two asynchronous serial interfaces that conform with the EIA standard RS-232C. Data rates are set for both interfaces together. These parameters are operator controlled and are defined in "Setup Parameters" in this chapter. Both interfaces can communicate at data rates up to 38.4K bits per second (bps).

## Keyboard

The keyboard consists of 83 keys mounted on a single-sided PCB. All keys are momentary action key switches. The microprocessor periodically scans the keys checking for key closures.

Figure 1-1 shows the keyboard. You can find a detailed description in Chapter 6, "Theory of Operations."

**Figure 1-1 Keyboard**



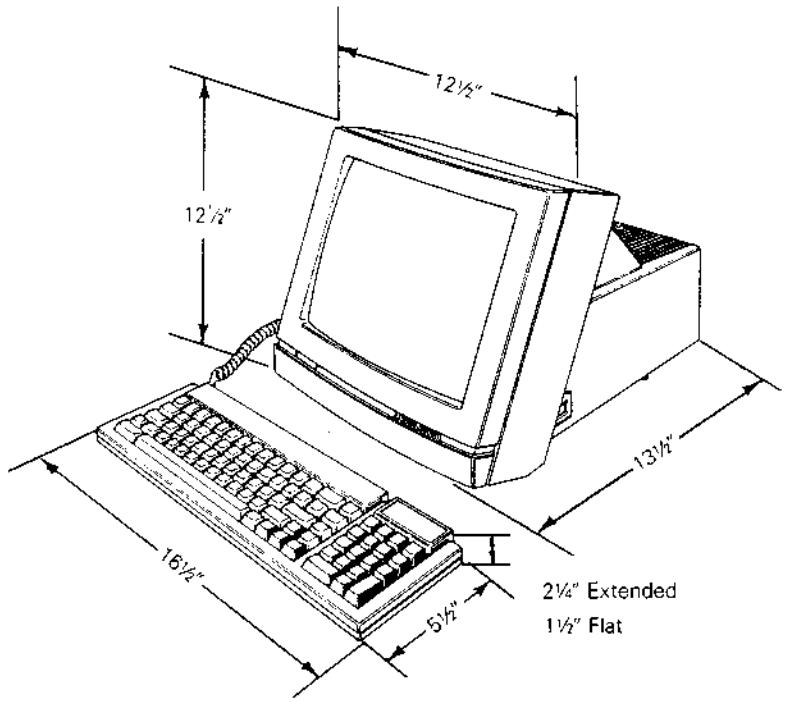
## ENVIRONMENT

The terminal can be placed on a table, desktop, or any other vibration-free horizontal surface that is free from lint and dust. Abnormally bright room light or direct sunlight can interfere with the display.

Figure 1-2 shows the WY-30 dimensions. The user should allow three inches of clearance on all sides when installing the terminal.

Users can install the terminal near most other types of electrical or electronic equipment without serious interference. They should avoid locations near strong magnetic fields that can distort and interfere with the operating or servicing of the video display.

**Figure 1-2 Terminal Dimensions**

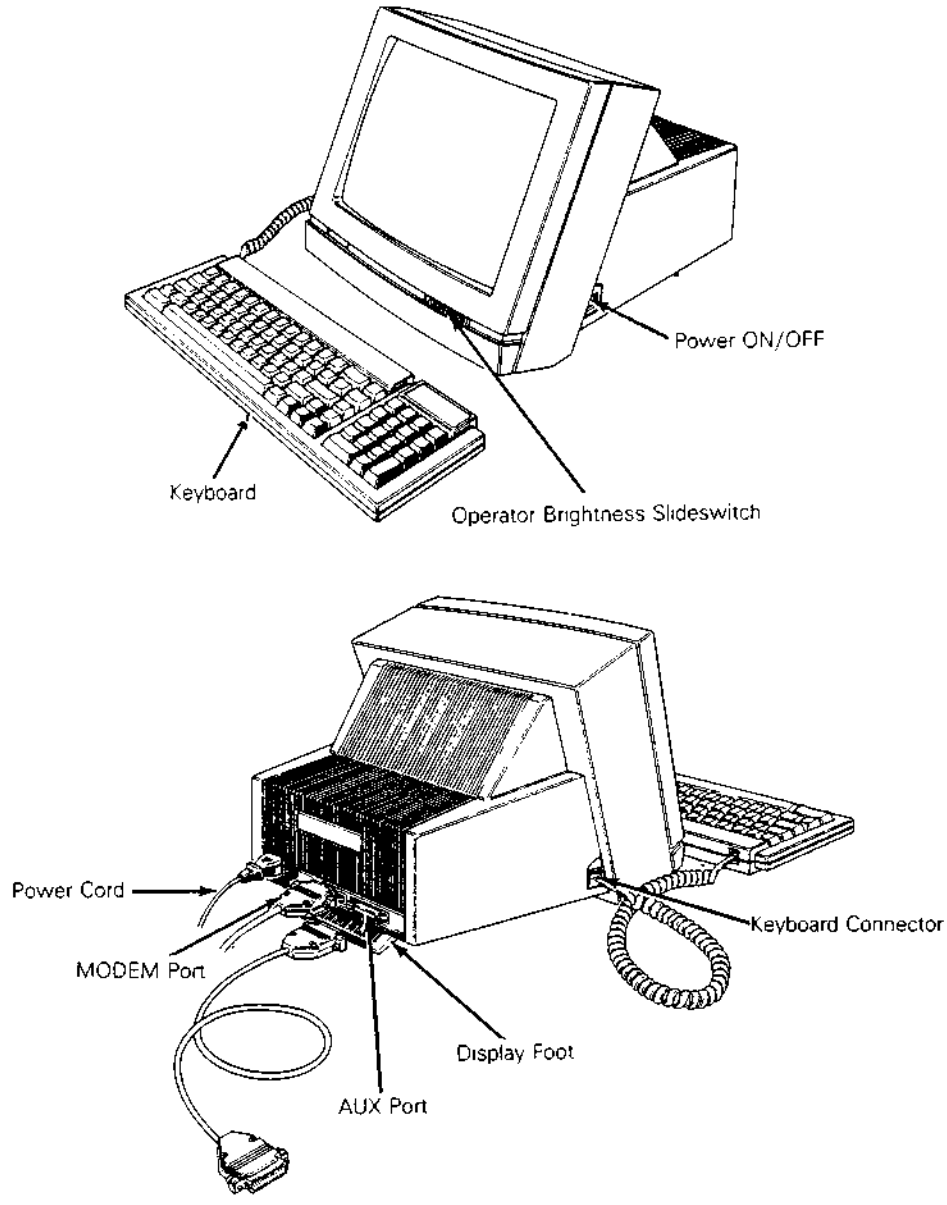



Ambient room temperature should never exceed 45 degrees Celsius (113 degrees Fahrenheit) when the terminal is on; however, the terminal needs no special cooling. Users should make sure the rear of the terminal has a free flow of air. They shouldn't set the terminal on sound-deadening devices that block the flow of air beneath it.

## OPERATOR INTERFACES

Figure 1-3 shows all operator interfaces, including the keyboard, power cord, and brightness slideswitch. It also points out the MODEM and AUX ports.

**Figure 1-3 Operator Interfaces**




### Keyboard

Plug the keyboard cable connector into the keyboard connector jack on the left side of the terminal.

### Power Cord

Insert the power cord into the connection on the rear panel, and then plug the three-pronged connector into the AC power source.

**Caution**--Compare the voltage specified on the configuration label (on the back of the CRT enclosure) with the AC power source to avoid damaging the terminal.

### Communications Cable

Connect the communications cable from the computer or modem to the communications port labeled MODEM. This port defaults at 9600 baud, no parity, with one stop bit and eight data bits. The operator can change these parameters in setup mode.

### AC Power Switch

The power switch is on the right side of the terminal. Pressing the back of the switch turns AC power on.

### Brightness Slideswitch

The brightness slideswitch is located on the lower-right corner of the front bezel. Sliding the switch to the right increases the display brightness; sliding it to the left decreases the brightness.

### Touch/Tilt Screen Adjustment

The touch/tilt screen adjustment is a spring-controlled support flap on the bottom of the terminal enclosure. A user can adjust the angle at which he views the screen by pushing or pulling the terminal bezel.

## SETUP PARAMETERS

When a user turns the power on, the terminal executes an internal self-test. When the self-test finishes and the CRT is warm (approximately 30 seconds), the cursor appears in the upper left-hand corner of the display. The unit is now ready for operation based on the setup parameters.

To inspect the parameters, press both the SHIFT and SETUP keys. The first level of parameters appears across the bottom of the screen. To examine the other levels of parameters, press the CURSOR DOWN key. Each time you press this key, you can see another level.

To change the parameters, follow these steps:

1. Enter setup mode by pressing the SHIFT and SETUP keys.

2. Press CURSOR DOWN until the parameter to be changed is displayed in the setup line, the row of highlighted fields at the bottom row of the screen.

3. Press CURSOR RIGHT or LEFT until the specific parameter to be changed is highlighted.

4. Press the spacebar to advance the parameter to the specific setting desired.

5. Press the cursor keys as required to advance to the next parameter to be changed.

6. To leave setup mode, press the SHIFT and SETUP keys.

   The status line flashes a message asking if the changed parameters should be saved for power-on. Parameter changes are implemented immediately.

   Pressing the Y key saves the parameters that you keyed in.

   Pressing the N key saves all changes temporarily. The new parameters are effective only until you turn off the power.

   Pressing the ESC key returns all parameters to their factory default values.

   Pressing the ENTER key restores all parameters from memory before leaving setup mode.

7. To return to a normal operation mode, press any key.

The terminal is now operational using the parameters defined in the setup mode.

See the WY-30 User's Guide for more comprehensive setup instructions.

**CLEANING**

You may find that the terminal needs to be cleaned when you've finish servicing it. The screen should be cleaned with a soft, lint-free cloth. Apply a safe cleaner to the cloth, not directly to the screen.

**Caution**--Don't ever clean the screen with chemical substances, abrasives, or commercial glass cleaners that contain alcohol or ammonia.

# 2 REMOVAL AND REPLACEMENT PROCEDURES


**Overview** ..... 2-2

**Before You Start** ..... 2-2
Safety ..... 2-2
Required Tools ..... 2-3

**Removing and Replacing Assemblies in the Keyboard Module** ..... 2-3
Keyboard ..... 2-3
Keyboard Cable ..... 2-4
Keyboard PCB ..... 2-5

**Removing and Replacing Assemblies in the Terminal Module** ..... 2-5
Removing the Terminal Enclosure ..... 2-6
Replacing the Fuse ..... 2-7
Replacing the Terminal PCB ..... 2-8
Replacing the CRT/Yoke Assembly ..... 2-10
Replacing the Yoke ..... 2-12
Replacing the Terminal Enclosure ..... 2-13
Discharging the Anode ..... 2-13

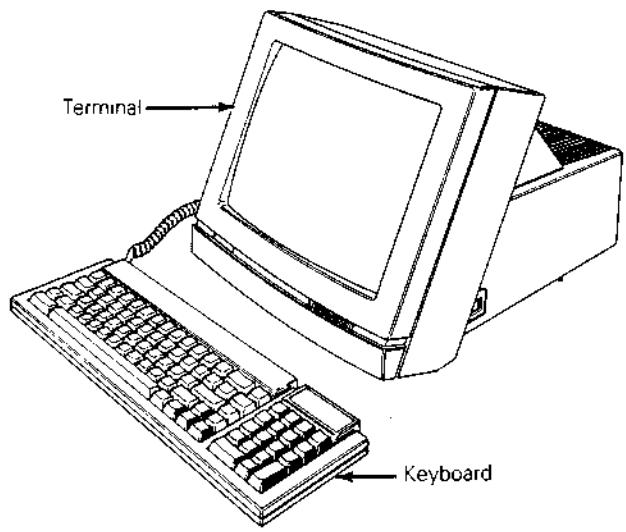
## OVERVIEW

This chapter explains how to remove and replace assemblies and components in both terminal modules. For purposes of orientation, "front" is the monitor face, and "back" is the rear panel and power cord location.

The terminal consists of two major modules (see Figure 2-1):

- o Terminal — The terminal module includes the CRT/yoke assembly and the terminal PCB. The terminal PCB holds all control logic, power supply circuitry, and the circuitry to amplify and display horizontal, vertical, and video signals on the CRT screen.
- o Keyboard — The keyboard module includes the keyboard PCB and the keyboard cable.

**Figure 2-1 Terminal Modules**




## BEFORE YOU START

### Safety

**Warning**--This terminal contains high voltage. Don't attempt to service the terminal without taking all the precautions necessary to work with high voltage, including the following:

- o If you must open the terminal for any reason, turn off the power, disconnect any communications cables, and unplug the terminal.

- Remove any jewelry, especially on hands and wrists.
- Avoid wearing clothing that holds a static charge.
- Use only insulated or nonconductive tools.
- Whenever you disconnect the anode lead from the anode, make sure to ground the anode as directed in "Discharging the Anode."
- If you need to remove or replace the CRT/yoke assembly, remember that it can implode if you drop it or break the neck. The flying glass can injure anyone within a radius six to ten feet.

### Required Tools

Before you remove or replace any assemblies in the terminal, ma sure you have the tools and materials listed below.

- No. 0 Phillips screwdriver
- No. 2 Phillips screwdriver
- Insulated flat-blade screwdriver
- Alligator clips
- Digital multimeter (or voltmeter)
- Nonscratch mat or surface
- Fuse puller or small flat-blade screwdriver

## REMOVING AND REPLACING ASSEMBLIES IN THE KEYBOARD MODULE

This section describes procedures to remove and replace the keyboard, keyboard cable, and keyboard PCB.

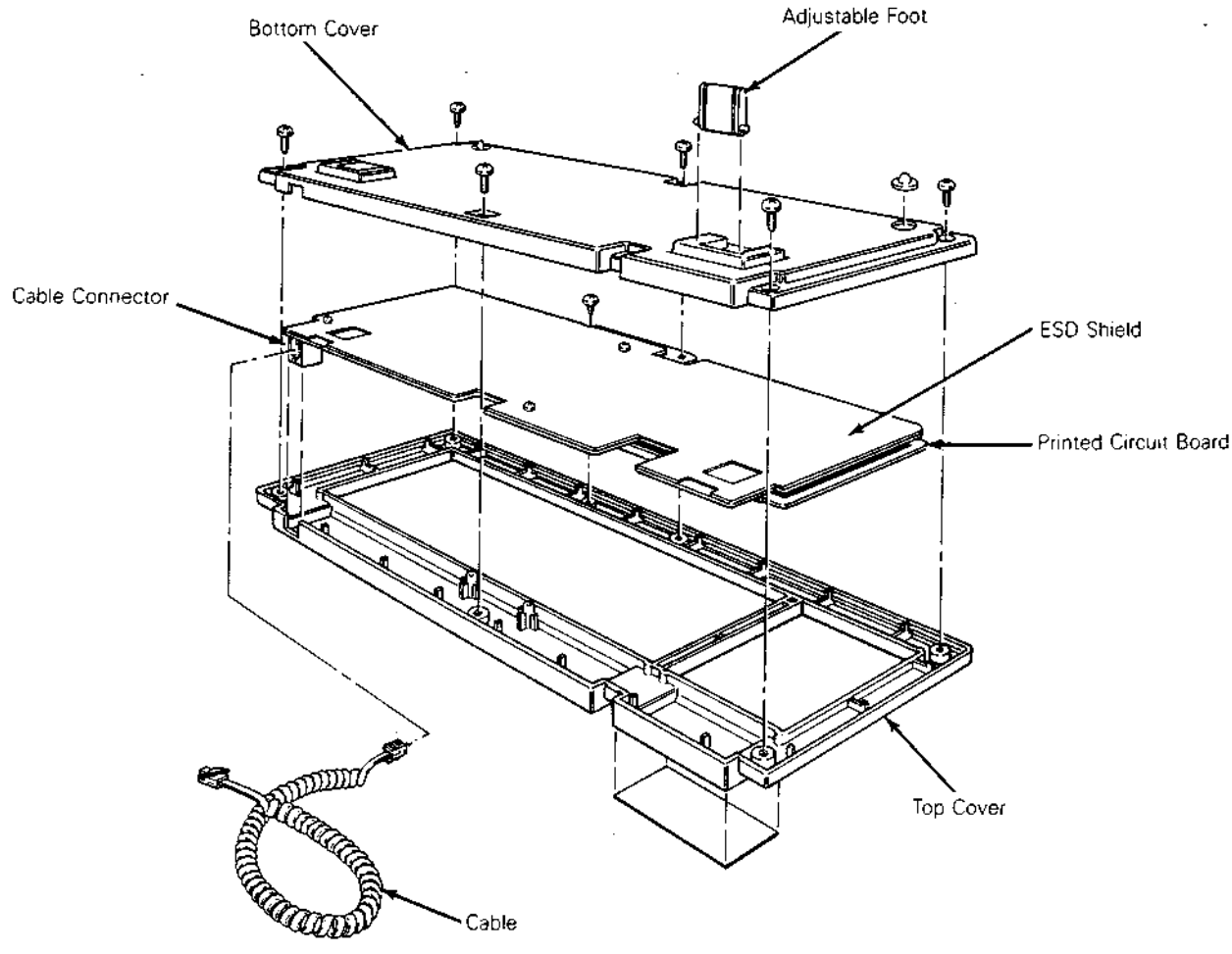
### Keyboard

Tools required: None

To replace the keyboard (see Figure 2-2), follow these steps:

1. Turn off the terminal.
2. Press the keyboard cable connector tab and pull the keyboa cable out of the keyboard.
3. Plug the keyboard cable into the new keyboard's connector.

**Figure 2-2 Keyboard Assembly**






## Keyboard Cable

Tools required: None

To replace the keyboard cable (see Figure 2-2), follow these steps:

1. Turn the terminal off.

2. Press the keyboard cable connector tab and pull the keyboard cable out of the keyboard.

3. Press the other keyboard cable connector tab and pull the keyboard cable out of the left side of the terminal.

4. Insert one end of the new keyboard cable into the keyboard connector. Insert the other end into the left side of the terminal.

**Keyboard PCB**

Tools required: No. 0 Phillips screwdriver

No. 2 Phillips screwdriver

To replace the keyboard PCB (see Figure 2-2), follow these step

1. Turn off the terminal.
2. Unplug the keyboard cable from the keyboard.
3. Turn the keyboard over and remove the six No. 2 Phillips screws that attach the keyboard bottom cover to the keyboard.
4. Lift off the keyboard bottom cover.
5. Remove the No. 0 Phillips screw beneath the spacebar that holds the keyboard top cover to the PCB assembly.
6. Unscrew the three No. 0 Phillips screws and washers that hold the keyboard ESD shield on the keyboard PCB.
7. Lift the PCB assembly out of the keyboard cover.
8. Cover the under side of the new keyboard PCB with the keyboard ESD shield. Replace the screws and washers. Tighten.
9. Fit the new keyboard PCB assembly back into the keyboard t cover.
10. Replace the No. 0 Phillips screw that holds the PCB assemb in place.
11. Reattach the bottom cover of the keyboard assembly.
12. Plug the keyboard cable back into the terminal.

## REMOVING AND REPLACING ASSEMBLIES IN THE TERMINAL MODULE

This section describes removing and replacing the terminal enclosure, the fuse, the terminal PCB, and the CRT/yoke assembl It also describes how to discharge the CRT anode.

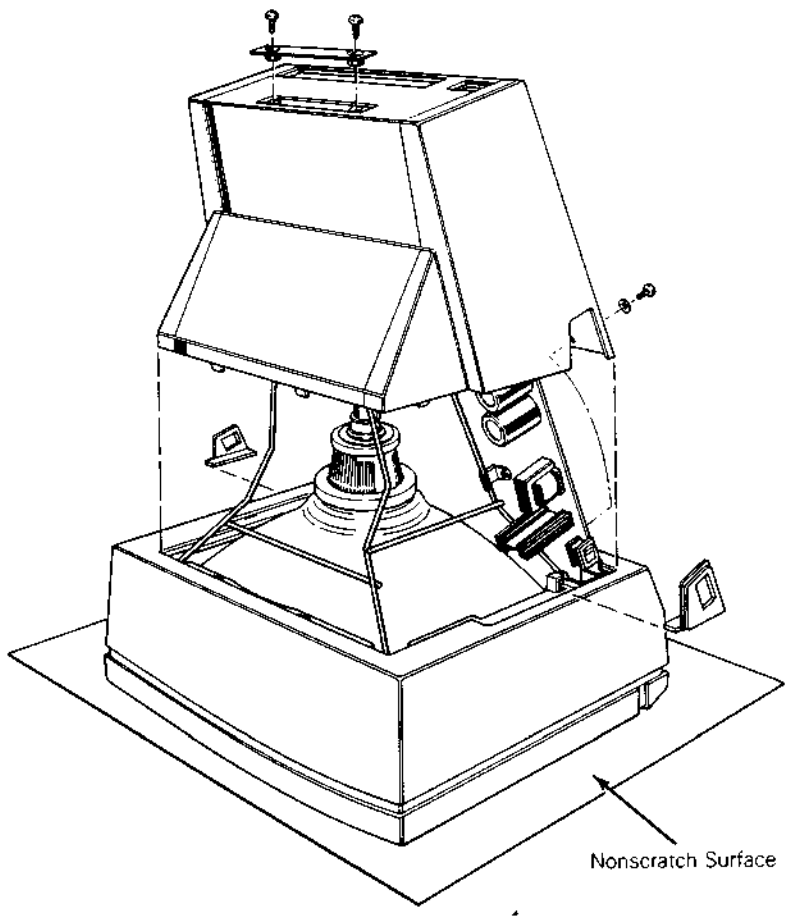
**Removing the Terminal Enclosure**

Tool required: No. 2 Phillips screwdriver

To remove the terminal enclosure (see Figure 2-3), follow these steps:

1. Remove all cables and power cords from the rear of the terminal.
2. Rest the display face of the terminal on a nonscratch surface.
3. Disconnect the keyboard cable on the left side of the terminal enclosure.
4. Remove two No. 2 Phillips screws from the rear panel of the terminal enclosure.
5. Remove two No.2 Phillips screws from the bottom of the terminal enclosure, next to the back bezel.
6. Lift off the terminal enclosure.

**Figure 2-3 Removing the Terminal Enclosure**



## Replacing the Fuse

Tool required: Fuse puller or screwdriver

The terminal has one fuse, rated 2 amps, 125 volts. See Figure 2-4 for the fuse location on the terminal PCB.

To check or replace the fuse, follow these steps:

1. Remove the terminal enclosure.

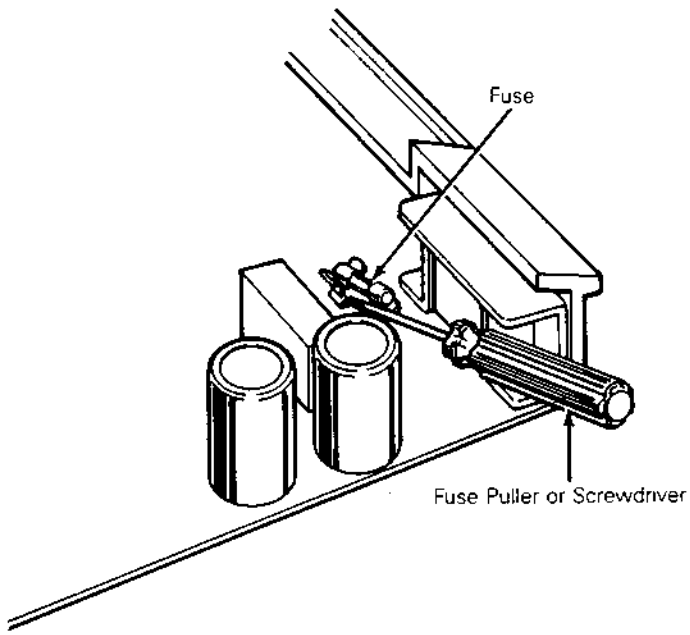
2. Use a fuse puller to remove the suspected fuse.

3. Check the fuse. If the fuse is broken or blackened, push a new fuse into the fuse socket.

   If the fuse is good, push it back into the fuse socket.

4. Replace the terminal enclosure (see "Replacing the Termina Enclosure" for instructions).

**Figure 2-4 Replacing the Fuse**



**Replacing the Terminal PCB**

Tools required: No. 2 Phillips screwdriver

Flat-bladed screwdriver

Alligator clips

To remove the terminal PCB (see Figure 2-5), follow these steps:

1. Remove the terminal enclosure.

2. Slide the barrier plates mounted on either side of the back bezel out from under the restraining tabs.

3. Leaving the terminal on its face, pull the back bezel off the terminal chassis.

4. Discharge the anode (see "Discharging the Anode" for instructions).

5. Disconnect the anode lead.

6. Disconnect the yoke harness connector, P201, from the terminal PCB.

   **Warning**--Handle the CRT neck carefully. If you break it, flying glass can injure anyone within a radius of six to ten feet.

7. Disconnect the filament harness from the neck of the CRT.

8. Unscrew the two Phillips No. 2 screws securing grounding wires to the CRT chassis.

   **Caution**--Don't remove the Phillips screws directly underneath the rear panel on the terminal PCB. They fasten the rear panel to the terminal PCB.

9. Remove the four plastic studs securing the ESD shield to the back of the terminal PCB.

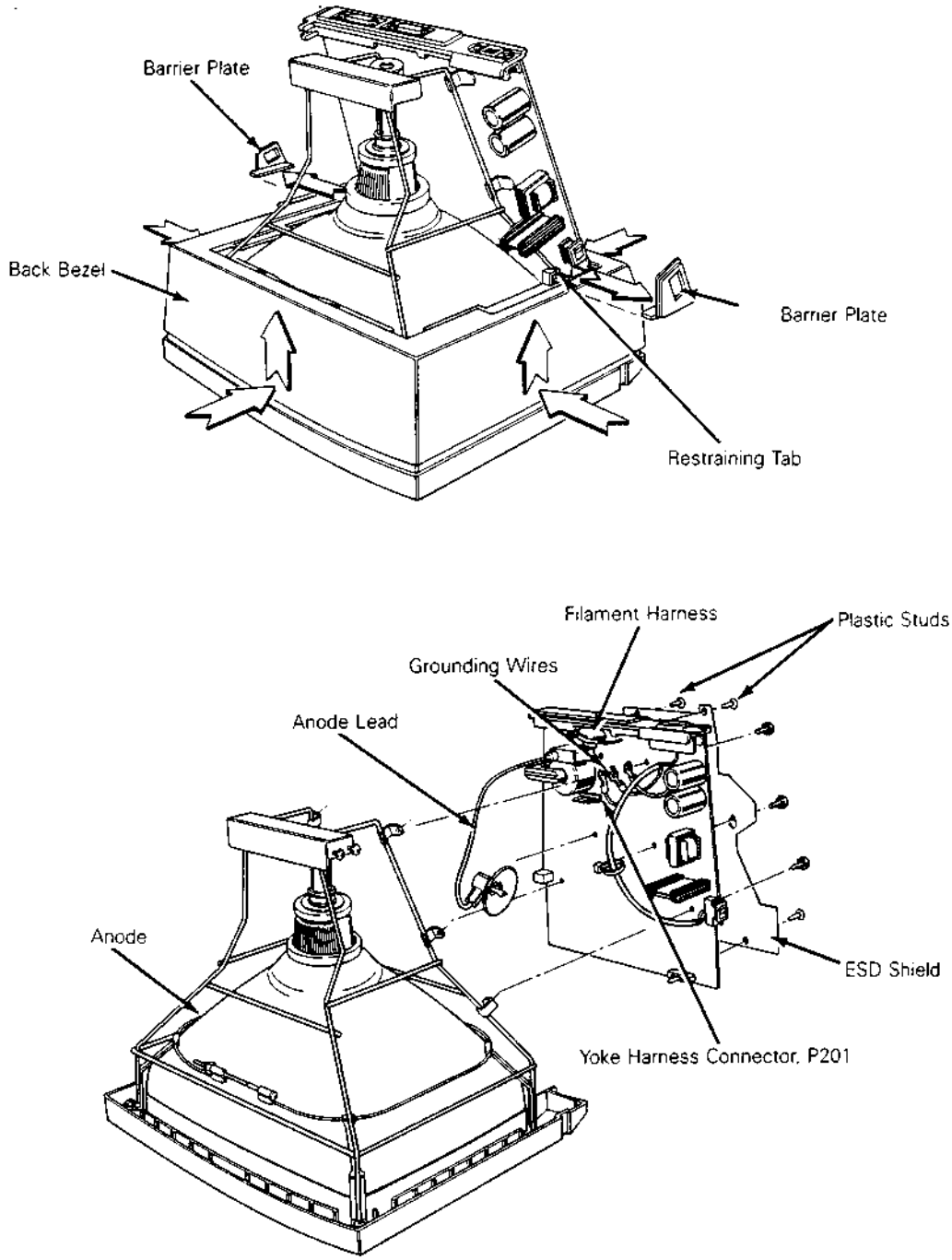
10. Loosen any screws holding the ESD shield in place.

11. Remove the ESD shield.

12. Loosen the six No. 2 Phillips screws on the underside of the terminal PCB.

13. Lift the terminal PCB up and out.

**Figure 2-5 Removing the Terminal PCB**



To replace the terminal PCB, follow these steps:

1. Position the ESD shield on the back of the terminal PCB.

2. Replace the four plastic studs that secure it.

3. Position the terminal PCB in its slot in the bezel. Make sure the lever of the brightness potentiometer fits into the brightness slideswitch on the bezel.

4. Tighten the six screws that secure the terminal PCB to the chassis.

5. Reconnect the grounding wires to the chassis.

6. Reconnect the yoke harness to P201 on the terminal PCB.

   **Warning**--Handle the CRT neck carefully. If you break it, flying glass can injure anyone within a radius of six to ten feet.

7. Reconnect the filament harness to the CRT neck.

8. Discharge the anode on the CRT (see "Discharging the Anode."

9. Reconnect the anode lead.

10. Replace the back bezel and both barrier plates.

11. Replace the terminal enclosure and keyboard.

**Replacing the CRT/Yoke Assembly**

Tools required: No. 2 Phillips screwdriver

Flat-bladed screwdriver

Alligator clips

To remove the CRT/yoke assembly (see Figure 2-6), follow these steps:

1. Remove the terminal enclosure, keyboard cable, back bezel, and barrier plates.

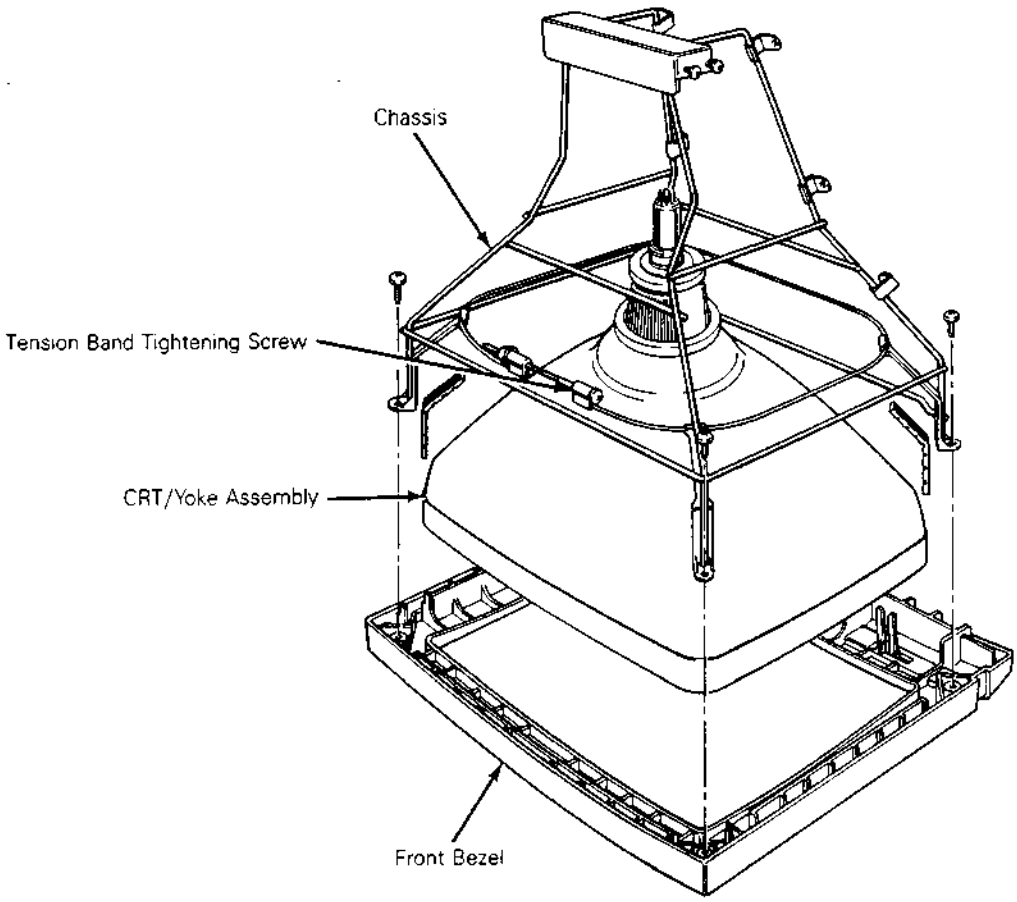
2. Remove the terminal PCB and insulation sheet.

3. Unscrew the four No. 2 Phillips screws securing the chassis to the front bezel.

   **Warning**--Handle the CRT carefully. If you break it, flying glass can injure anyone within a radius of six to ten feet.

4. Lift up the chassis, and remove the CRT/yoke assembly.

**Figure 2-6 Removing the CRT/Yoke Assembly**




To replace the CRT/yoke assembly, follow these steps:

1. Discharge the anode on the new CRT.

   **Warning--**If you are replacing the same CRT/yoke assembly, you still need to discharge the anode. A CRT left standing for any length of time will develop a charge from the air, and need to be discharged again.

2. Place the assembly in the front bezel. Make sure the anode faces the keyboard connector jack on the terminal PCB.

3. Fit the chassis back into the bezel.

4. Replace the four No. 2 Phillips screws that secure the assembly to the chassis. Tighten.

5. Replace the terminal PCB and insulator sheet.

6. Make sure the tension band is tight. If it isn't, tighten it.

7. Replace the back bezel, barrier plates, and keyboard cable.

8. Replace the terminal enclosure.

**Replacing the Yoke**

Tools required: None

To remove the yoke, follow these steps:

1. Remove the CRT/yoke assembly from the terminal.

2. Loosen the yoke lock on the neck of the CRT (see Figure 2-7).

3. Remove the yoke.

To replace the yoke, follow these steps:

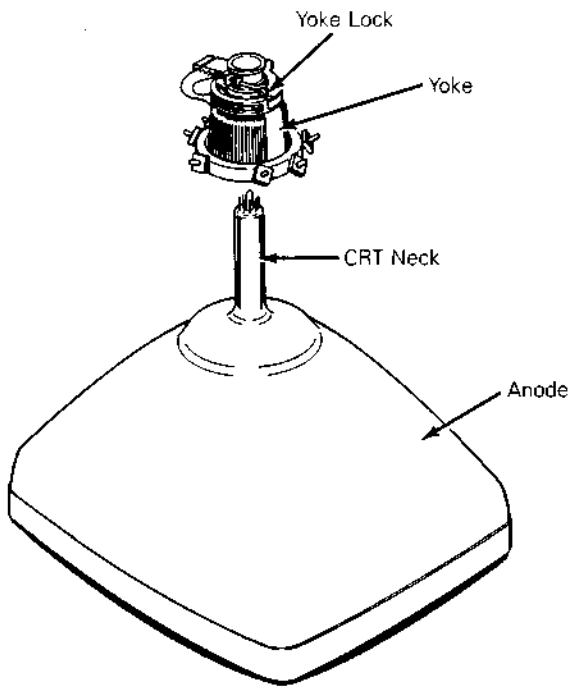
**Warning**--Before you reattach the yoke assembly, you must discharge the anode. A CRT left standing for any length of time will develop a charge from the air, and need to be discharged again.

1. Position the yoke on the neck of the CRT (see Figure 2-7).

2. Tighten the yoke lock.

3. Replace the CRT/yoke assembly in the terminal.

**Figure 2-7 Replacing the Yoke**



## Replacing the Terminal Enclosure

Tool required: No. 2 Phillips screwdriver

To replace the terminal enclosure, follow these steps:

1. With the terminal face on a nonscratch surface, reseat the enclosure over the chassis into the back bezel.

2. Replace the two No. 2 Phillips screws on the rear of the terminal enclosure. Tighten.

3. Replace the two No. 2 Phillips screws on the bottom of the terminal. Tighten.

## Discharging the Anode

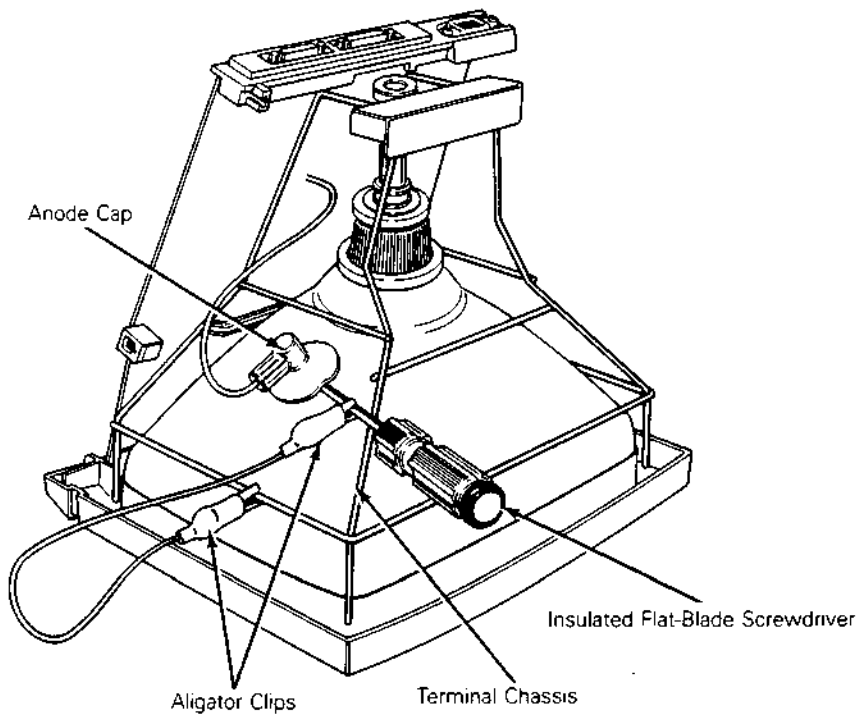
Tools required: Insulated flat-blade screwdriver

Alligator clips

We have written specific warnings throughout this chapter about discharging the anode on the side of the CRT. If you have never discharged the anode, or need a review, follow these instructions.

To discharge the CRT anode before removal (see Figure 2-8), follow these steps:

**Figure 2-8 Discharging the Anode Before Removal**



1. Turn off the terminal and unplug it from its power source.

2. Remove the terminal enclosure.

3. Ground the shaft of an insulated flat-bladed screwdriver to the terminal chassis with alligator clips.

4. Slip the blade between the anode cap and the anode. Touch the blade to the wire anode leads under the cap. Listen for a popping or crackling sound.

5. Remove the anode lead.

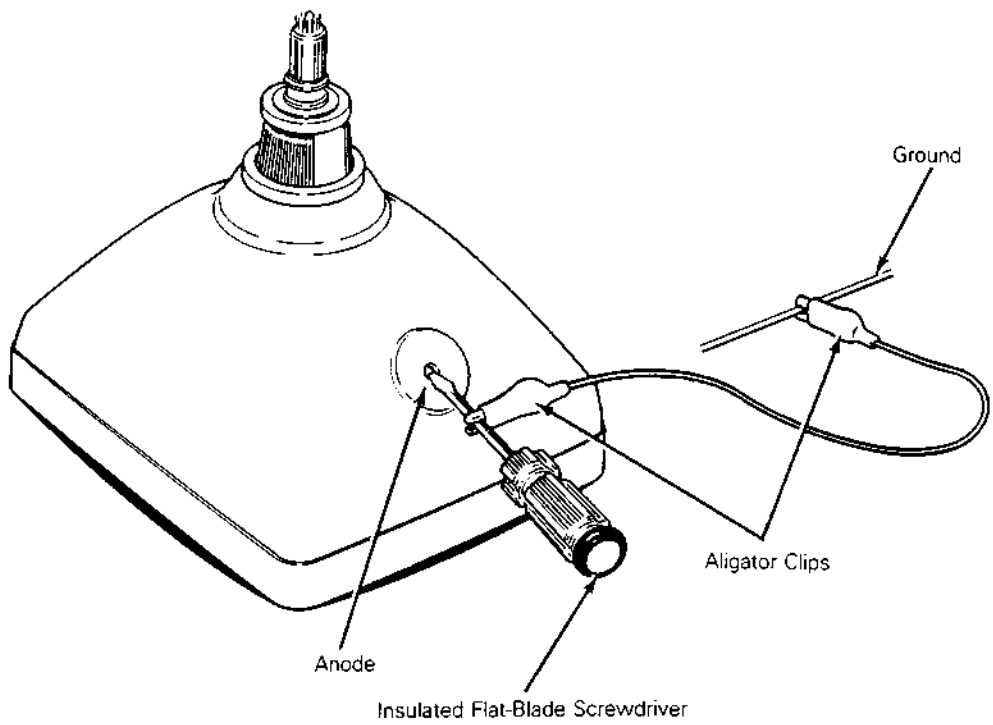
To discharge the anode before installation (See Figure 2-9), follow these steps:

1. Ground the shaft of an insulated flate-bladed screwdriver.

2. Touch the blade of the screwdriver to the anode. Listen for a popping or crackling sound.

3. Install the CRT.

**Figure 2-9 Discharging the Anode Before Installation**



# 3 TROUBLESHOOTING

**Before You Start** ..... 3-2
Safety ..... 3-2
Required Tools ..... 3-2

**Troubleshooting Quick Reference Guide** ..... 3-3

**Troubleshooting Flowchart** ..... 3-3

**Troubleshooting Aids** ..... 3-8
Installation Checklist ..... 3-8
Checking for Continuity ..... 3-9
Power Supply Check on the Terminal PCB ..... 3-9
Power-On Self-Test ..... 3-10
Diagnostic Self-Test ..... 3-11
Checking the Keyboard ..... 3-12
Isolating Circuits ..... 3-13

## BEFORE YOU START

### Safety

**Warning**--This terminal contains high voltage. Don't attempt to service the terminal without taking all the precautions necessary for working with high voltage, including the following:

- If you must open the terminal for any reason, turn off the power, disconnect any communication cables, and unplug the terminal.
- Remove any jewelry, especially from your hands and wrists.
- Avoid wearing clothing that holds a static charge.
- Use only insulated or nonconductive tools.
- Whenever you disconnect the anode from the anode lead, make sure to discharge the anode as directed in Chapter 2.
- If you need to remove or replace the CRT/yoke assembly, remember that the CRT can implode if you drop it or break the neck. The flying glass can injure anyone within a radius of six to ten feet.

### Required Tools

Before you start to repair in the terminal, make sure you have the tools and materials listed below.

- No. 2 Phillips screwdriver
- 3/16-inch flat-bladed screwdriver
- Digital multimeter (or an ohmmeter and voltmeter)
- Test connectors for the MODEM and AUX ports (See Appendix C for instructions to make them or Chapter 5 for ordering information.)
- Nonconductive video alignment tool
- Tie-wraps and clippers

## TROUBLESHOOTING QUICK REFERENCE GUIDE

Table 3-1 is a troubleshooting reference guide. Once you discover the major symptoms, this table can quickly direct you to the most likely problem area. However, don't automatically replace the suggested modules until you've studied the problem or checked related details in the troubleshooting flowchart.

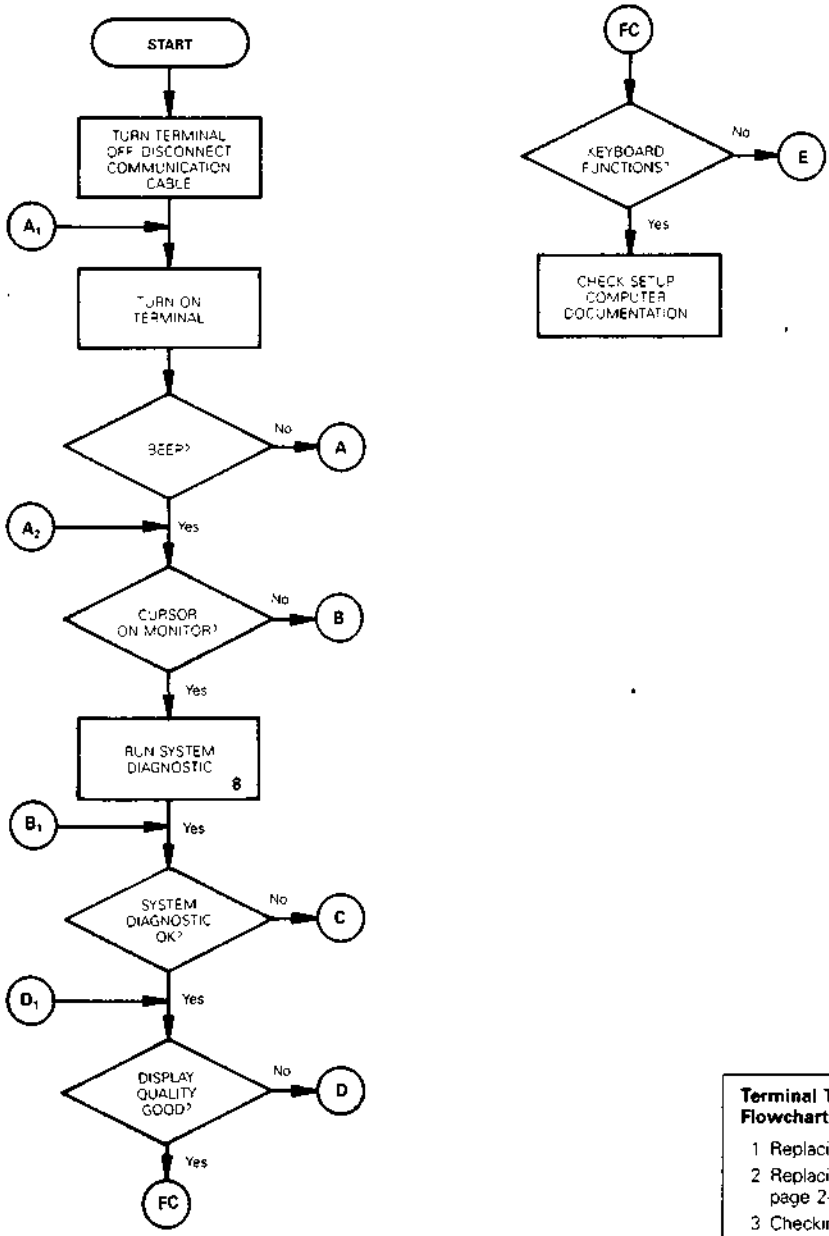
**Table 3-1 Troubleshooting Quick Reference Guide**

| Symptom | Possible Problem Area(s) |
|---|---|
| No display | Terminal PCB, CRT/yoke assembly |
| Poor display quality | Adjustments, terminal PCB |
| Wrong size display<br>Crooked<br>Too bright<br>Not in focus | Adjustments, terminal PCB, yoke |
| Fails self-test | Terminal PCB |
| Fails diagnostic test | Terminal PCB, wrong diagnostic setup, faulty test connectors |
| Inoperative keys | Keyboard, terminal PCB, keyboard cable |
| Can't communicate with computer | Setup parameters, terminal PCB, communication cable |
| Letters or error codes on the screen | Terminal PCB |
| Touch/tilt doesn't respond correctly | Touch/tilt screw tension |

## TROUBLESHOOTING FLOWCHART

Read the troubleshooting flowchart and match the symptoms with the suggested solutions. Any flowchart block that requires a procedure includes a bold number that is keyed to the legend on each page of the flowchart. The legend lists the procedure name and the page number in this manual where you can find the necessary procedure.

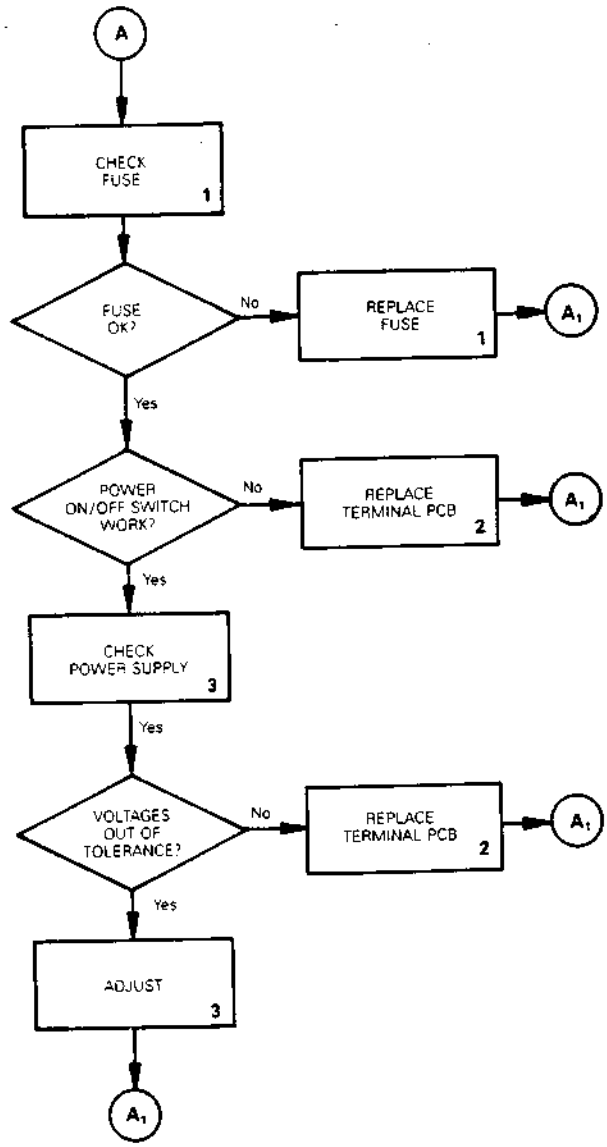
Figure 3-1 Troubleshooting Flowchart, page 1 of 4




**Terminal Troubleshooting Flowchart Legend**

1 Replacing the Fuse, page 2-7
2 Replacing the Terminal PCB, page 2-8
3 Checking the Power Supply, page 4-3
4 Replacing the CRT/Yoke Assembly, page 2-10
5 Aligning the Brightness, page 4-8
6 Aligning the Display, page 4-6
7 Replacing the Yoke, page 2-12
8 Running the Diagnostic Self-Test, page 3-11
9 Checking the Keyboard, page 3-12
10 Checking the Communications Cable, page 3-8
11 Replacing the Keyboard, page 2-3

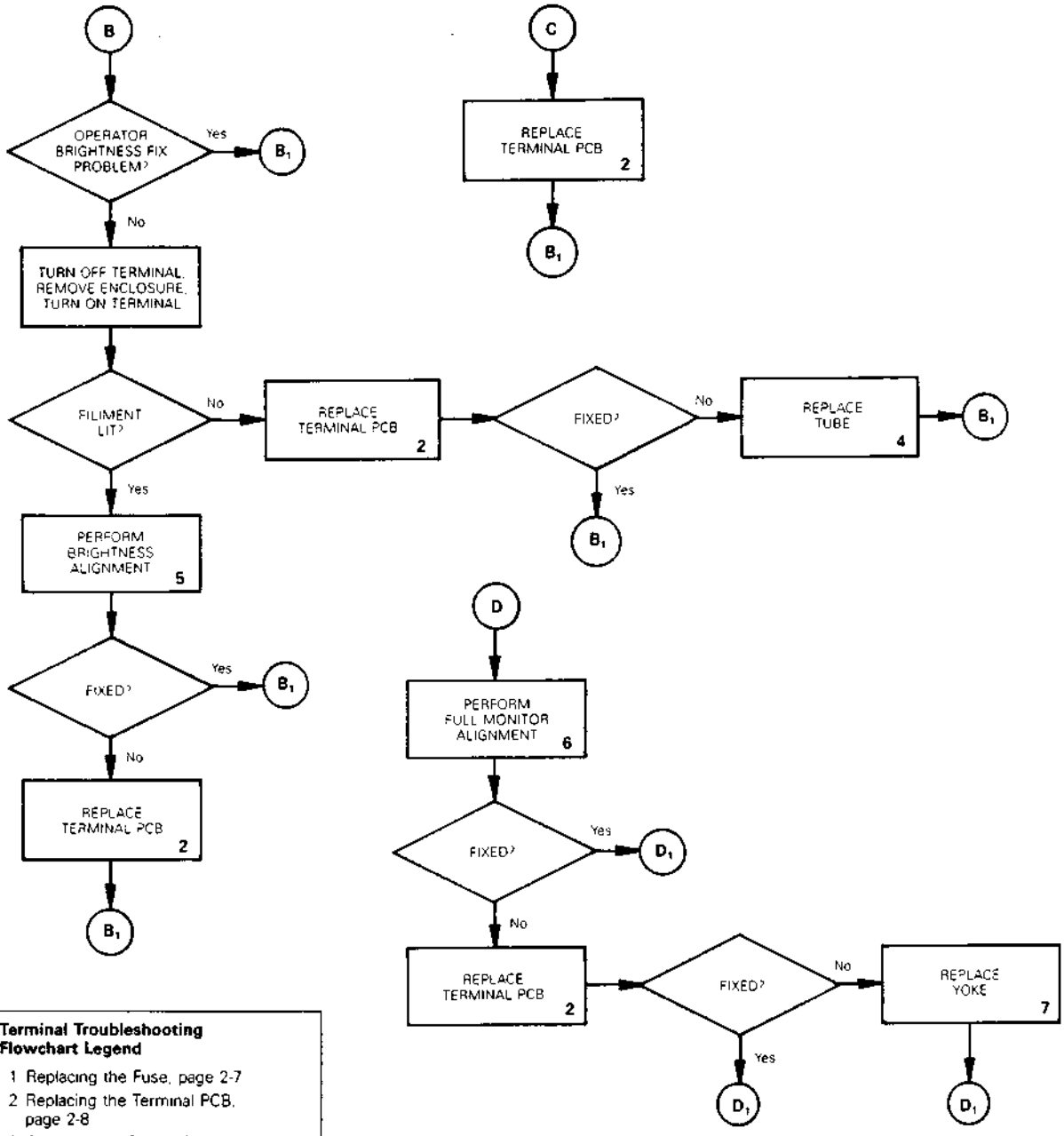
Figure 3-1 Troubleshooting Flowchart, page 2 of 4




**Terminal Troubleshooting Flowchart Legend**

1 Replacing the Fuse, page 2-7
2 Replacing the Terminal PCB, page 2-8
3 Checking the Power Supply, page 4-3
4 Replacing the CRT/Yoke Assembly, page 2-10
5 Aligning the Brightness, page 4-8
6 Aligning the Display, page 4-6
7 Replacing the Yoke, page 2-12
8 Running the Diagnostic Self-Test, page 3-11
9 Checking the Keyboard, page 3-12
10 Checking the Communications Cable, page 3-8
11 Replacing the Keyboard, page 2-3

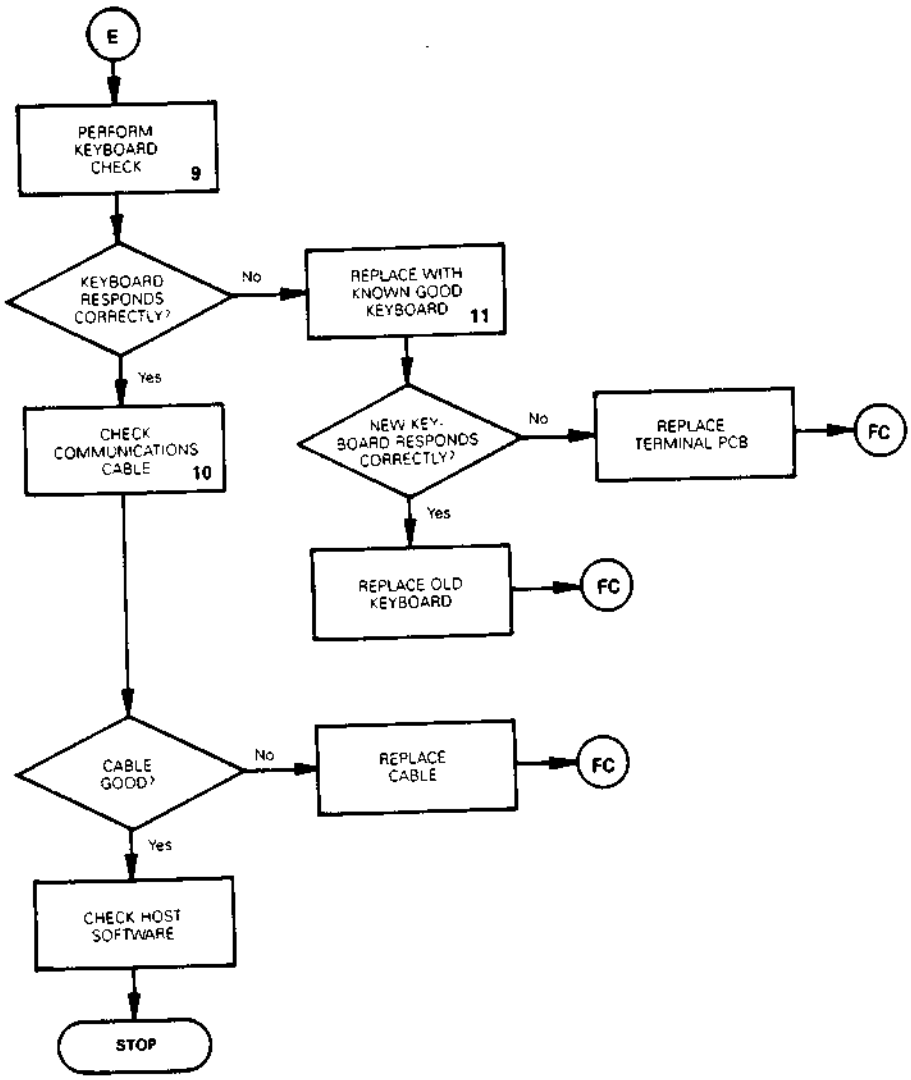
## Figure 3-1 Troubleshooting Flowchart, page 3 of 4




**Terminal Troubleshooting Flowchart Legend**

1 Replacing the Fuse, page 2-7
2 Replacing the Terminal PCB, page 2-8
3 Checking the Power Supply, page 4-3
4 Replacing the CRT/Yoke Assembly, page 2-10
5 Aligning the Brightness, page 4-8
6 Aligning the Display, page 4-6
7 Replacing the Yoke, page 2-12
8 Running the Diagnostic Self-Test, page 3-11
9 Checking the Keyboard, page 3-12
10 Checking the Communications Cable, page 3-8
11 Replacing the Keyboard, page 2-3

Figure 3-1 Troubleshooting Flowchart, page 4 of 4




**Terminal Troubleshooting Flowchart Legend**

1 Replacing the Fuse, page 2-7
2 Replacing the Terminal PCB, page 2-8
3 Checking the Power Supply, page 4-3
4 Replacing the CRT/Yoke Assembly, page 2-10
5 Aligning the Brightness, page 4-8
6 Aligning the Display, page 4-6
7 Replacing the Yoke, page 2-12
8 Running the Diagnostic Self-Test, page 3-11
9 Checking the Keyboard, page 3-12
10 Checking the Communications Cable, page 3-8
11 Replacing the Keyboard, page 2-3

## TROUBLESHOOTING AIDS

This section contains a number of specialized procedures to help you repair the terminal. Most of them are referenced on the troubleshooting flowchart.

### Installation Checklist

The checklist in Table 3-2 helps you quickly check terminal installation. If a user installs the terminal incorrectly, it may not function properly. If you can't find the problem, improper installation may be the key.

**Table 3-2 Terminal Installation Checklist**

**Environment**

___ Room temperature is between +40 and +91 degrees Fahrenheit (5 and 33 degrees Celsius).

___ Terminal isn't near a magnetic field.

**Keyboard**

___ Keyboard cable is in the keyboard connector jack on the left side of the terminal.

___ Keyboard cable is in the connector jack on the rear of the keyboard.

**AC Power Cord**

___ Female end of the power cord is plugged into the AC power socket on the rear panel of the terminal.

___ Male end of the power cord is plugged into the wall socket.

**Communication Interface Cable**

___ One end of the RS-232C interface cable is connected to the MODEM port on the terminal's rear panel.

___ The other end of the interface cable is correctly connected to the computer.

Table 3-2 Continued

**Computer Interface**

You'll need to check the computer's documentation to determine the following information:

___ Correct baud rate

___ Correct stop bits

___ Correct data bits

___ Correct parity type

___ Correct handshaking protocol

**Checking for Continuity**

Sometimes you can fix the problem without opening the terminal. The problem could be a damaged cable or power cord. Sometimes, you may need to open the terminal to check the fuse or internal connections. Check this list, then, with an ohmmeter, check the continuity of the components listed below.

Outside the terminal, check the

- Power cord
- Communication cable (supplied with the computer)

Inside the terminal, check the

- Fuse
- AC power input receptacle (on the rear panel of the terminal)
- Terminal PCB to the CRT/yoke wiring harness

Hold the probes in place for five seconds, or until the ohmmeter settles, to ensure an accurate reading. If the part in question is open, replace it.

**Power Supply Check on the Terminal PCB**

You can quickly isolate problems if you check power supply voltages on the terminal PCB.

Tools required: No. 2 Phillips screwdriver

Digital multimeter

Nonconductive video alignment tool

To check the voltages, follow these steps:

1. Turn the terminal off.
2. Remove the terminal enclosure.
3. Attach one lead from the DMM to the chassis as ground.
4. Turn the terminal on.
5. With the other lead from the DMM, look for these voltages at these points on the terminal PCB:

| Voltage | Point |
|---|---|
| +5V ±5% | R15 |
| +12V ±5% | C27 |
| -12V ±5% | C31 |

6. If one or more of these voltages are not in tolerance, adjust VR101.
7. If you adjust VR101, and the voltage or voltages are still not within tolerance, replace the terminal PCB.

**Power-on Self-Test**

The power-on self-test checks the terminal's random-access memory (RAM), read-only memory (ROM), electrically eraseable read-only memory (EEROM), and external communication ports.

Each time you turn the terminal on, the power-on self-test occurs. If the test detects an error, an error message appears on the display. Table 3-3 defines these error messages. If any of these messages appear, replace the terminal PCB.

**Table 3-3 Power-On Self-Test Error Messages**

| Error Message | Failure |
|---|---|
| K | EEROM checksum error |
| O | RAM error |
| X | MODEM port TXD/RXD error |
| C | MODEM port DTR/DCD error |
| A | MODEM port RTS/CTS error |
| Y | AUX port error |
| 9 | EEROM read/write error |
| P | PROM checksum error |

### Diagnostic Self-Test

The terminal diagnostic self-test routine starts in setup mode. This test routine includes communications circuitry tests, read/write tests, and row buffer tests. Two special test connectors allow the diagnostic test to function (see Appendix C for connector definitions or Chapter 5 for ordering information). After you start it, the diagnostic test continues to run until you stop it. If the test detects an error, an error message appears in the lower right-hand corner of the screen (see Table 3-4 for error message definitions).

Follow these steps to start the diagnostic self-test:

1. Turn the terminal off.
2. Detach any communications cables on the back of the terminal.
3. Attach the test connectors to the MODEM and AUX ports that are on the rear panel of the terminal.

   **Note**--See Appendix C for a description of these test connectors and instructions for making them.
4. Turn the terminal on.
5. Hold the SHIFT key, then press the SETUP key.
6. Press CURSOR DOWN five times. Look for to the TEST:OFF field in the setup line at the bottom of the screen.
7. Press CURSOR RIGHT four times.

8. Press the spacebar. This toggles the TEST field ON.

9. Hold SHIFT, then press SETUP. Press N. You should see a flashing test pattern.

10. Look for one of the error messages found in Table 3-4.

    **Note**--To fully test the terminal, let the diagnostic self-test run five minutes.

11. If you see an error message, replace the terminal logic PCB; if you don't see an error, press SETUP twice.

12. Turn the terminal off. Remove the test connectors, and reattach the communications cables.

**Table 3-4 Diagnostic Self-Test Error Messages**

| Error Message | Failure |
|---|---|
| A | RTS to CTS data communications error on MODEM port |
| C | DTR to DCD data communications error on MODEM port |
| K | EEROM data check sum error |
| 0 | RAM error |
| X | Transmit/receive data error on MODEM port |
| Y | Printer port error |
| 9 | EEROM read/write diagnostic self-test error |
| P | Program ROM check sum error |

### Checking the Keyboard

If you suspect the keyboard is the source of the problem, follow this procedure to verify it:

1. Turn the terminal off.

2. Disconnect the communication cable.

3. Connect pins 2 and 3 on the MODEM port.

4. Turn the terminal on.

5. The terminal should be in FDX (full-duplex) mode. (If it isn't, go into setup mode, select the FDX parameter, then leave setup mode.)

6. Type on the keys. Test all the keys in shifted and unshifted positions. If the keys don't respond, see section E of "Troubleshooting Flowchart."

## Isolating Circuits

If you troubleshoot to the component level using the schematics in Chapter 7, you may want to isolate the logic, monitor, or power supply circuitry. Table 3-5 is a list of jumpers on the terminal PCB and the areas they isolate. For an exact location, see the terminal PCB component layout in Chapter 5.

**Table 3-5 Terminal PCB Circuit Isolation Jumpers**

| Jumper | Areas Isolated |
|---|---|
| J525<br>J526 | Ground from logic |
| J524<br>J527 | Power supply from logic |
| J543 | Video circuit<br>Logic from monitor circuitry |
| J522 | Vertical synchronization<br>Logic from monitor circuitry |
| J545 | Horizontal synchronization<br>Logic from monitor circuitry |
| J725 | Dim circuit<br>Logic from monitor circuitry |

# 4 ADJUSTMENTS AND ALIGNMENTS


**Before You Start** ..... 4-2
Safety ..... 4-2
Tools Required ..... 4-2

**Power Adjustments** ..... 4-3

**Does the Terminal Meet the Display Specifications?** ..... 4-4

**Aligning the Terminal Display** ..... 4-6

**Adjustments** ..... 4-7
Height ..... 4-7
Vertical Hold ..... 4-7
Linearity ..... 4-8
Brightness ..... 4-8
Focus ..... 4-9
Width ..... 4-9
Display Leveling ..... 4-9
Display Magnets ..... 4-11
Centering Rings ..... 4-12

## BEFORE YOU START

### Safety

**Warning**--This terminal contains high voltage. Don't attempt to service the terminal without taking all the precautions necessary for working with high voltage, including the following:

- If you must open the terminal for any reason, turn off the power, disconnect any communication cables, and unplug the terminal.
- Remove any jewelry, especially on your hands and wrists.
- Avoid wearing clothing that holds a static charge.
- Use only insulated or nonconductive tools.
- Whenever you disconnect the anode from the anode lead, make sure to ground the anode as directed in Chapter 2, "Discharging the Anode."
- If you need to remove or replace the CRT/yoke assembly, remember that it can implode if you drop it or break the neck. The flying glass can injure anyone within a radius of six to ten feet.

### Tools Required

Before you test the power supply voltages or make any adjustments to the power supply or monitor assemblies, make sure you have the tools listed below.

- Flat-bladed nonconductive alignment tool
- Hex nonconductive alignment tool
- No. 2 Phillips screwdriver
- Digital voltmeter
- Oscilloscope
- Millimeter ruler or reticle (optional--see Appendix D for instructions on how to use the reticle when you align the terminal display)

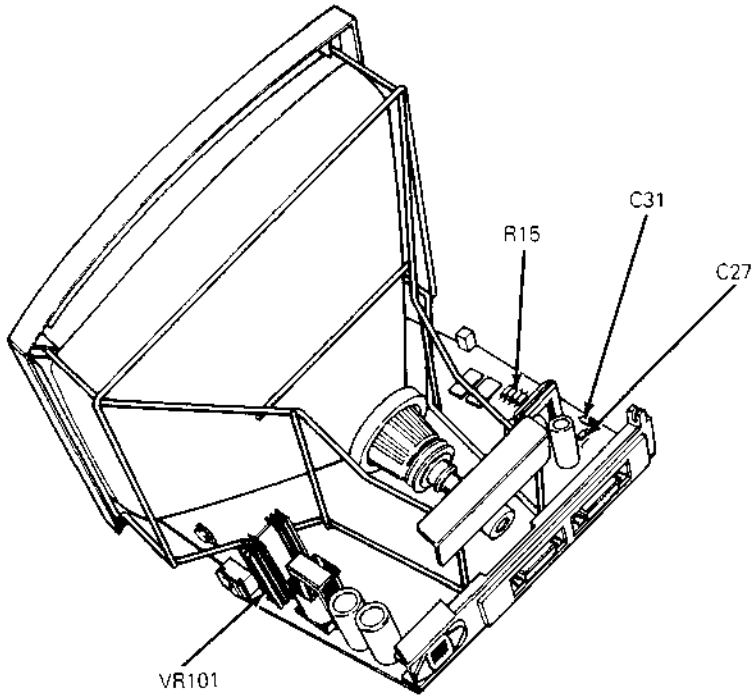
**Note**--Before you make any adjustments on the power supply or monitor assembly, make sure to let the terminal warm-up for 30 minutes.

## POWER ADJUSTMENTS

The monitor/power supply PCB provides all of the voltages for the logic (+5V, +12V, and -12V). You can adjust the +5 supply.

**Note**--You can find the locations of all components and test points referred to in this chapter in Figure 4-1.

**Figure 4-1 Power Supply Component Layout**




To adjust the power supply, follow these steps:

1. Turn the terminal off.
2. Unplug the power cord from the back of the terminal. If communications cables are attached to the back of the terminal, detach those, too.
3. Place the terminal on its face and remove the terminal enclosure and back bezel (see Chapter 2).
4. Plug the terminal into an AC power source.
5. Turn the terminal on.
6. Check the +5V supply at R15 on the terminal PCB, using the chassis as ground.
7. Adjust VR101 until the digital voltmeter reads between 4.9 and 5.1 volts.

**Note**--If you can't bring the +5V supply into tolerance, see Chapter 3, "Troubleshooting."

8. Check the -12V supply at C31 on the terminal PCB. The digital voltmeter should read -12V (±5 percent). If the -12V supply is not within tolerance after you have adjusted the +5 supply, see Chapter 3, "Troubleshooting."

9. Check the +12V supply at C27 on the terminal PCB. The digital voltmeter should read +12V (±5 percent). If the +12V supply is not within tolerance after you have adjusted the +5 supply, see Chapter 3, "Troubleshooting."

10. Turn the terminal so the screen is visible. Set the terminal PCB on a surface where the traces will not touch other metal.

11. Check to see if the display needs alignment. (See "Does the Terminal Meet the Display Specifications?.") If it doesn't need alignment, turn off the terminal, unplug it, and replace the top cover.

    If the display needs alignment, go to "Aligning the Terminal Display."

## DOES THE TERMINAL MEET THE DISPLAY SPECIFICATIONS?

Before you adjust the display on the monitor, measure the screen margins and study the display, following the procedure below.

**Note**--If you have just finished checking and adjusting the power supplies, go to step 4.

1. Turn the terminal off.

2. Unplug the power cord from the back of the terminal.

3. If any communications cables are attached to the back of the terminal, detach them.

4. Attach the test connectors to the MODEM and AUX ports on the rear panel.

   **Note**--See Appendix C for a description of these connectors and instructions for making them. See Chapter 5 for ordering information.

5. Plug in the power cord and turn the terminal on. Let it run for 30 minutes.

   **Note**--If you check the display before it runs for 30 minutes, your measurements may not be accurate.

6. Hold the SHIFT key, then press the SETUP key.

7. Press CURSOR DOWN five times. Look for the TEST:OFF field in the setup line at the bottom of the screen.

8. Press CURSOR RIGHT four times.

9. Press the spacebar. This toggles the TEST field ON.

10. Hold the CTRL key, then press the SETUP key. Press the N key. You should see a flashing test pattern.

11. Hold down the spacebar until the test pattern stops flashing.

12. Margins on the top, bottom, and both sides should measure 11mm (±2mm). If they don't, see the next section, "Aligning the Terminal Display."

13. Look at the display. Do you see any of these problems?

    - o Barreling (display edges that curve outwards)
    - o Pincushioning (display edges that curve inwards)
    - o Display edges aren't straight
    - o Display is too wide or too narrow
    - o Display is too high or too short
    - o Display isn't centered or level
    - o Poor focus
    - o Too dim or too bright
    - o Poor contrast
    - o Letters at the top of the pattern are a different size than the letters the bottom
    - o Letters aren't uniform throughout



If you find any of the problems mentioned here, go to the next section, "Aligning the Terminal Display."

If the display is within specification and looks normal, turn the terminal off. If the terminal was opened, you can close it, remove the connectors, and reattach the communications cables.

## ALIGNING THE TERMINAL DISPLAY

**Warning**--The CRT/yoke assembly has high voltages. Only qualified service personnel should perform these adjustments.

The monitor has several alignments and adjustments. If the terminal display is out of tolerance in one or two areas, make adjustments to correct only those problems. If you change the CRT/yoke assembly or the terminal PCB, you must perform a full alignment. **Peform these procedures only if the display is out of tolerance and doesn't match the specification.**

**Note**--If you already have the test pattern on the screen, go to step 9.

To align the terminal display, follow these steps:

1. Turn the terminal off.

2. Disconnect the communications cables and power cord.

3. Attach the test connectors to the MODEM and AUX ports on the rear panel.

   **Note**--See Appendix C for a description of these connectors and instructions for making them.

4. Plug the power cord into the back of the terminal and turn it on. Let it run for 30 minutes. (If it has already run for 30 minutes, continue the procedure.)

5. Hold the SHIFT key, then press the SETUP key.

6. Press CURSOR DOWN five times. Look for the TEST:OFF field in the setup line at the bottom of the screen.

7. Press CURSOR RIGHT four times.

8. Press the spacebar. This toggles the TEST field ON.

9. Hold the CTRL key, then press the SETUP key. Press the N key. You should see a flashing test pattern.

10. Hold down the spacebar until the test pattern stops flashing.

11. Adjust the display. Check Figure 4-1 for component locations.

**Note**--If you finish both the power and display adjustments, and the display still has problems, see Chapter 3, "Troubleshooting."

**Table 4-1 Display Problems and Adjustments**

| Display Problems | Adjustments | Page |
|---|---|---|
| Letters at the top of the display aren't the same height as those at the bottom of the display | Linearity | 4-8 |
| Fuzzy letters | Focus | 4-9 |
| Too bright; too dim; raster scan lines show; individual problems with or dim | Brightness | 4-8 |
| Display too short or too tall | Height | 4-7 |
| Too wide or too narrow | Width | 4-7 |
| No vertical hold | Vertical hold | 4-7 |
| Not centered | Centering rings | 4-12 |
| Not level | Yoke lock | 4-9 |
| Pincushioning, barreling, crooked edges, corners sag or move out of specification | Display magnets | 4-10 |

## ADJUSTMENTS

This section contains detailed instructions for each adjustment mentioned in Table 4-1. Figure 4-2 can help you to identify adjustment locations on the terminal PCB.

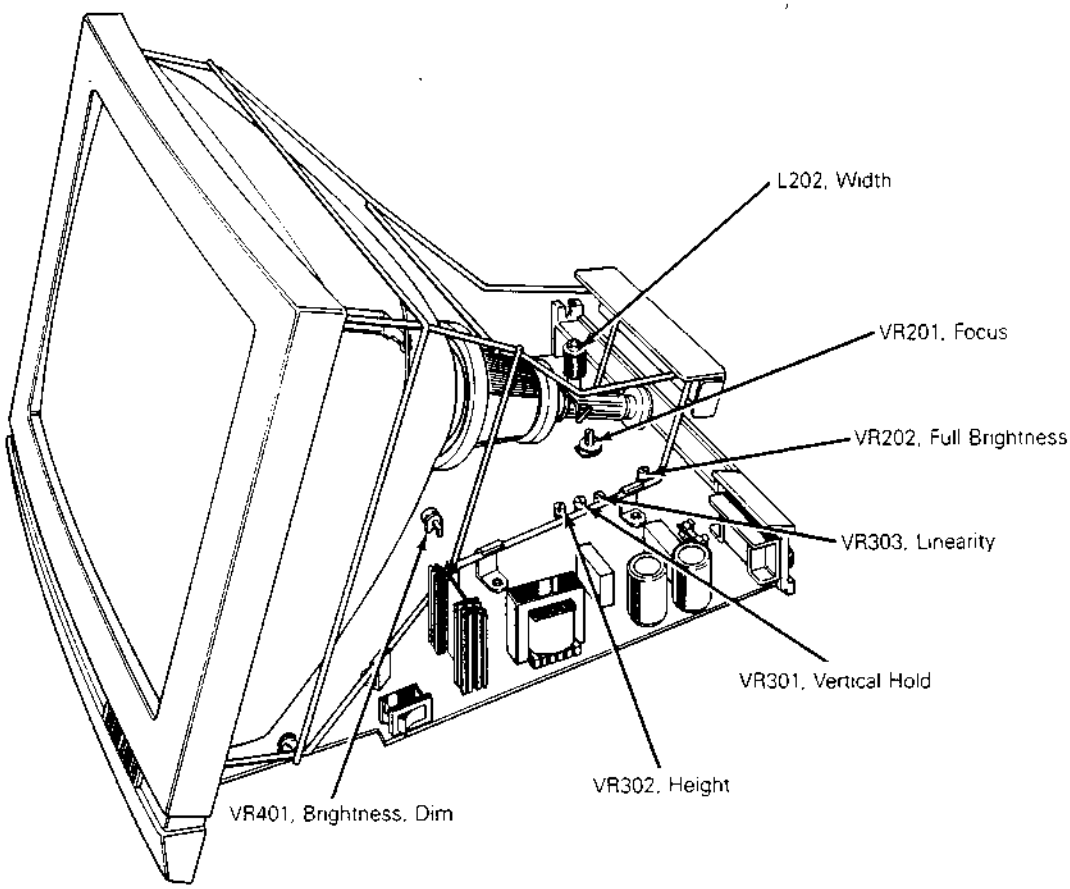
### Height

The height adjustment is labeled VR302 on the terminal PCB. Adjust VR302 until the top edge and the bottom edge of the display are both 11mm (±2mm) from the edge of the bezel.

### Vertical Hold

The height adjustment is labeled VR301 on the terminal PCB. Adjust VR301 until the display is steady and the video dosen't roll.

**Figure 4-2 Adjustment Locations**




## Linearity

The linearity adjustment is labeled VR303 on the terminal PCB. Adjust VR303 until characters on the bottom of the display are the same height as those on the top.

## Brightness

You can adjust bright and dim separately. Although you can adjust them independently, it's a good idea to adjust bright first, and then dim.

1. Slide the brightness slideswith as far right as possible (full brightness).

2. Turn VR202 on the terminal PCB as far clockwise as possible. You should see the raster lines on the screen.

3. Slowly turn VR202 counterclockwise, just until the raster is no longer visible. VR202 adjusts full brightness.

4. Compare the full bright line-blocks in the test pattern to the dim line-blocks in the test pattern. If dim looks either too bright or not bright enough, adjust VR401 until the contrast looks correct.

**Focus**

**Note**--Do not use the focus control to adjust the outer extremities of the screen. Some focus distortion happens in any CRT.

The focus adjustment is labeled VR201 on the terminal PCB. Adjust VR201 until the characters halfway between the center of the display and the bezel are distinct and clear.

**Width**

**Caution**--Do not use a metal tool to adjust the width coil. The magnetic properties of a metal tool will affect the adjustment.

The width adjustment is labeled L202 on the terminal PCB. With a hex nonconductive alignment tool, adjust L202 until either side of the display is 11mm (±2mm) from the edge of the bezel.

**Display Leveling**

The yoke lock is located on the neck of the CRT (see Figure 4-3).

To level the display, follow these steps:

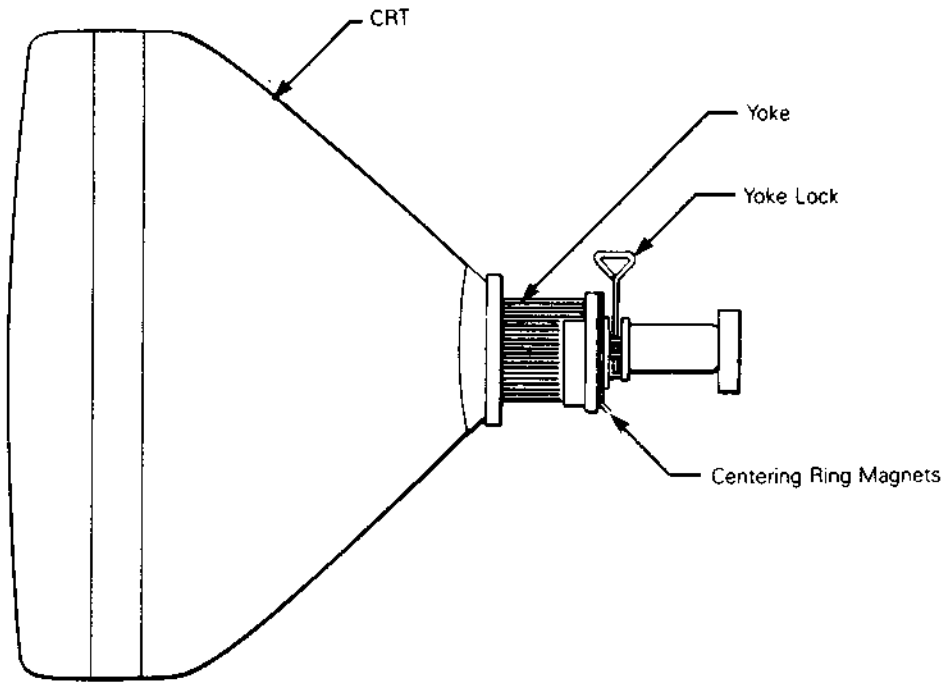
1. Loosen the yoke lock on the neck of the CRT.

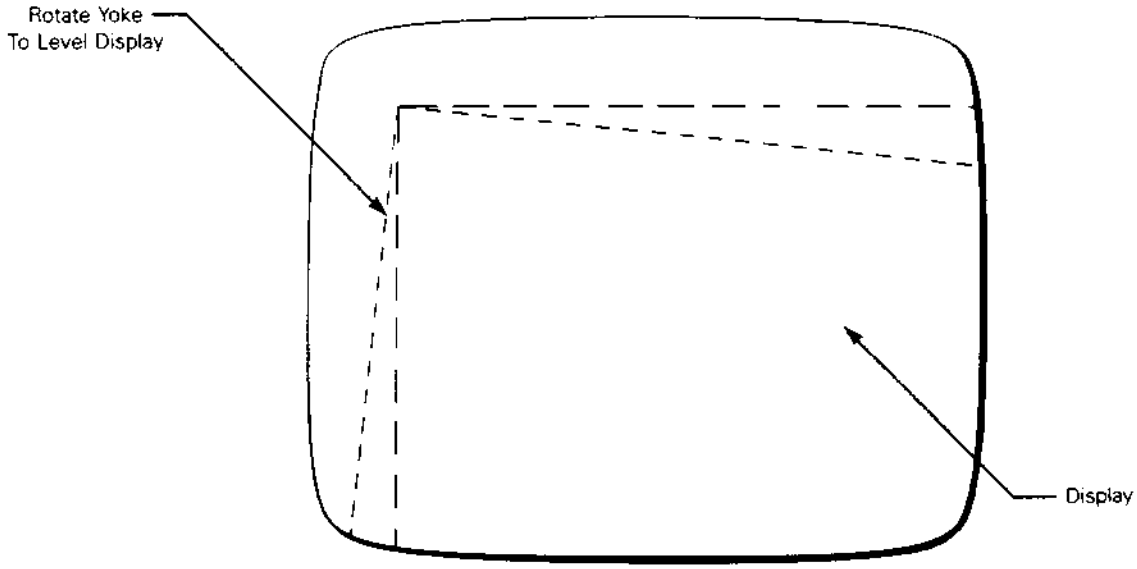
2. Rotate the yoke until the top and bottom edges of the display are level with the top and bottom of the bezel.

3. Tighten the yoke lock.

**Warning**--Do not tighten the yoke lock too much or the neck of the CRT will break causing the CRT to implode. The flying glass can injure anyone within a radius of six to ten feet.

**Figure 4-3 Yoke Lock on the CRT Neck**



## Display Magnets

There are eight display magnets on a ring around the yoke. When turned, they change corresponding screen areas. They can also affect adjacent areas. Figure 4-4 identifies each magnet; Table 4-2 identifies which portion of the screen each changes.

**Figure 4-4 Display Magnets**

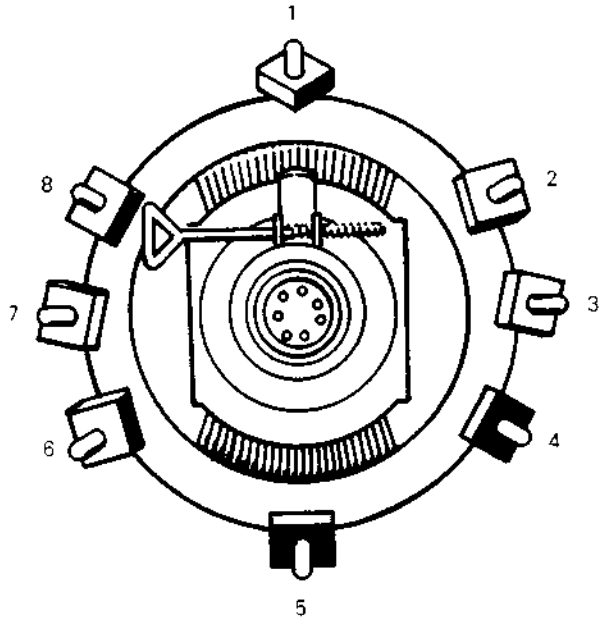


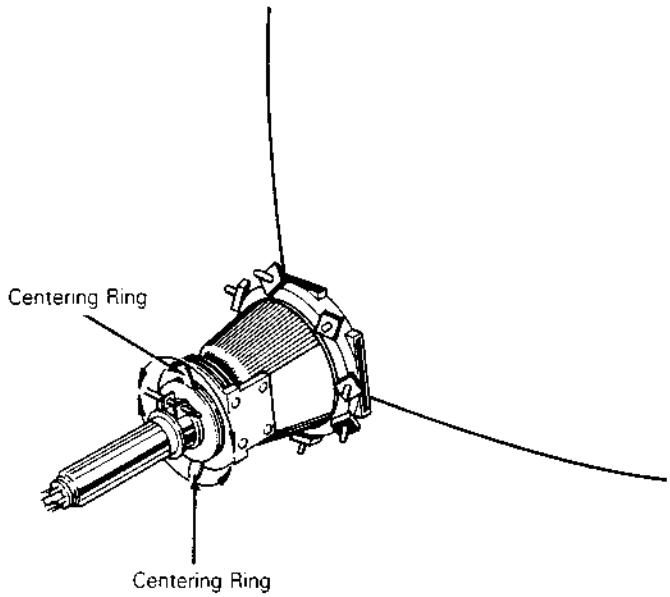

**Table 4-2 Screen Areas Affected by Display Magnets**

| Magnet Number | Area Affected |
|---|---|
| 1 | Top |
| 2 | Upper left corner |
| 3 | Left |
| 4 | Lower left corner |
| 5 | Bottom |
| 6 | Lower right corner |
| 7 | Right |
| 8 | Upper right corner |

## Centering Rings

There are two display centering rings around the yoke. When turned, they move the display position on the screen. Figure 4-5 shows the rings. If the display isn't in the center of the screen, turn the rings until it is, then make height and width adjustments described on pages 4-7 and 4-9.

**Figure 4-5 Centering Rings**



# 5 ILLUSTRATED PARTS LIST

Introduction ..... 5-2
Terminal Display Assembly Exploded View ..... 5-3
Keyboard Assembly Exploded View ..... 5-4
Terminal Components List ..... 5-5
Keyboard Components List ..... 5-8
Terminal Board Assembly Layout ..... 5-9

## INTRODUCTION

This chapter provides the information you need to order parts for the terminal.

The first part of this chapter provides two exploded assembly drawings: Figure 5-1, the terminal display, and Figure 5-2, the keyboard. Each replaceable assembly, plastic covering, or cable is labeled on the drawings with a specific part name and part number. When you order replacement parts, please give both the part name and the part number.

In the second part of this chapter, we list all piece parts, their values or generic industry numbers when relevant, and locations on the terminal PCB or the keyboard PCB. Table 5-1 lists components on the terminal PCB. Table 5-2 lists components on the keyboard PCB. Figure 5-3 is the terminal PCB component layout and Table 5-3 lists the diagnostic self-test connectors.

**Figure 5-1 Terminal Display Assembly Exploded View**

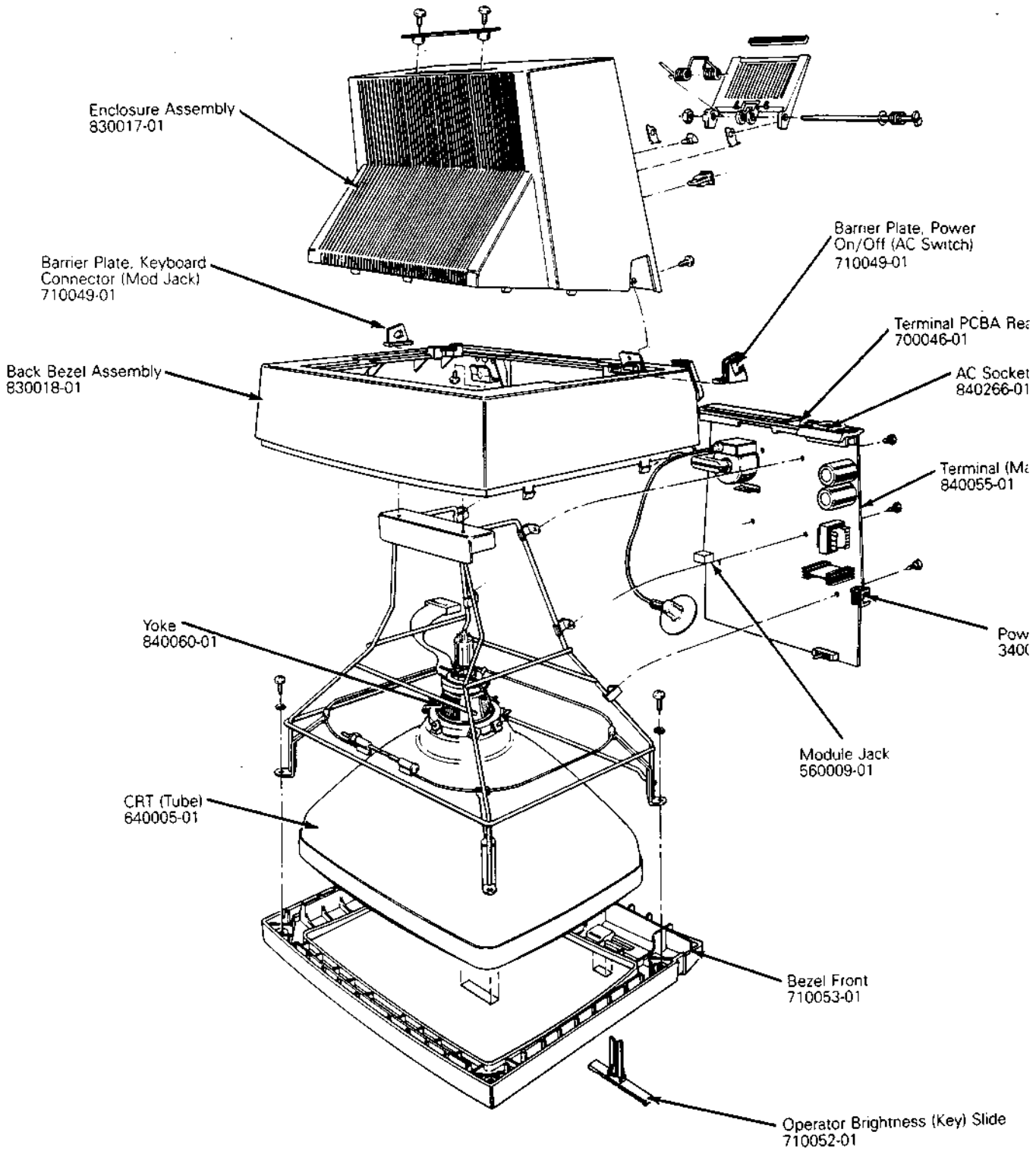
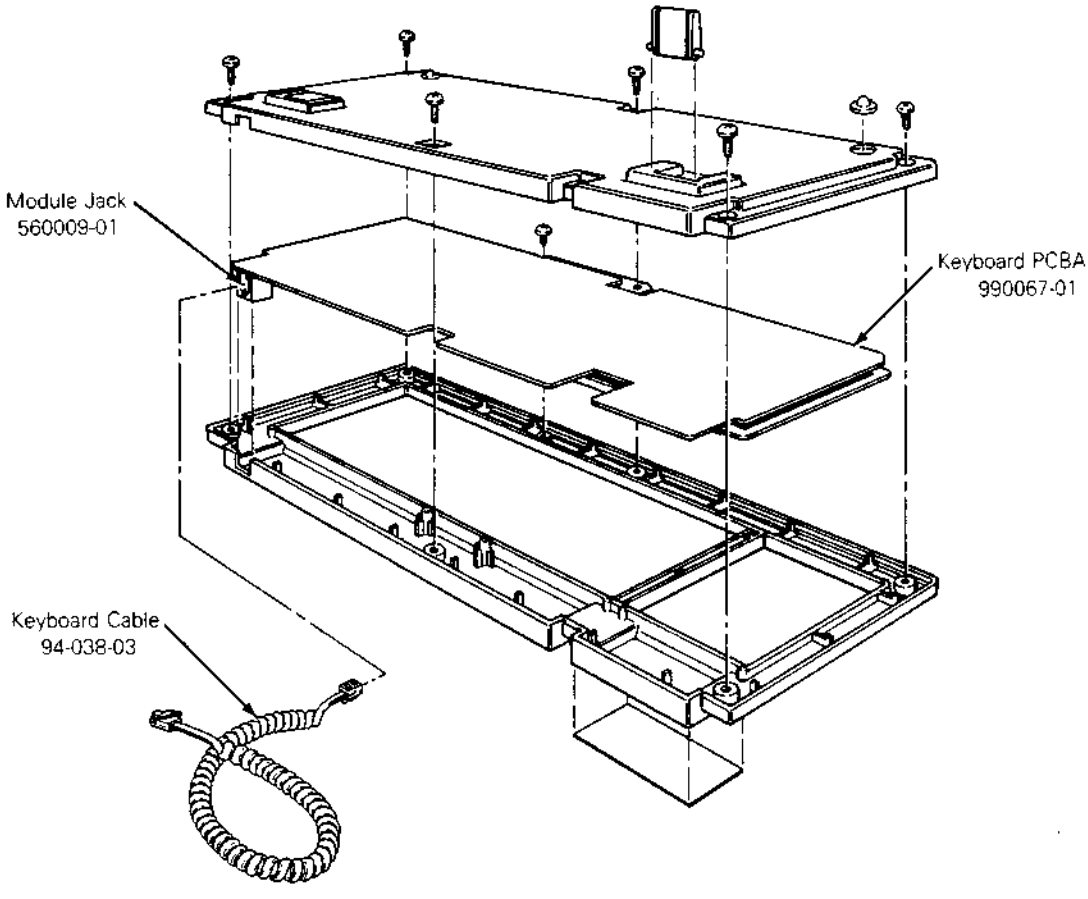


**Figure 5-2 Keyboard Assembly Exploded View**




Keyboard Assembly 840013-01

Table 5-1 Terminal PCB Components List

| Part Number | Description | Location |
|---|---|---|
| **Integrated Circuits** | | |
| 230129-01 | ASY FIRMWARE CHAR. GEN. PRO | U12 |
| 250220-01 | ASY FIRMWARE PROGRAM PROM | U18 |
| 80-300-02 | PPT BEEPER,AUDIO | B1 |
| 80-400-00 | PPT IC 74LS00 | U4 |
| 80-400-04 | PPT IC 74LS04 | U14,U5 |
| 80-400-09 | PPT IC 74LS139 | U29 |
| 80-400-11 | PPT IC 74LS174 | U24 |
| 80-400-15 | PPT IC 74LS374 | U13,U15,U16 |
| 80-400-24 | PPT IC 74LS132 | U20 |
| 80-400-26 | PPT IC 74LS74 | U26 |
| 80-400-27 | PPT IC 74LS283 | U7,U9 |
| 80-400-29 | PPT IC 74LS158 | U3,U6,U8 |
| 80-400-34 | PPT IC 74LS138 | U23 |
| 80-400-64 | PPT IC 74LS368 | U19 |
| 80-430-04 | PPT IC 4016 2K x 8K STATIC RAM | U1,U2 |
| 80-431-12 | PPT IC 2661-B | U22 |
| 80-431-34 | PPT IC CRT CNTL 6845RA 2MHZ | U10 |
| 80-431-40 | PPT IC 68B00 MICROPROCESSOR | U17 |
| 80-432-00 | PPT IC 1488 | U27 |
| 80-432-01 | PPT IC 1489 | U28 |
| 80-432-15 | PPT IC ADJ. SHUNT REGULATOR | IC102 |
| 80-432-20 | PPT IC TDA 1170N | IC301 |
| 80-432-23 | PPT IC 4N35 | IC101 |
| 80-435-12 | PPT IC GATE ARRAY (VIDEO) | U11 |
| 80-520-10 | ER5911A 1024 BIT EEROM | U25 |
| **Resistors** | | |
| 80-161-29 | PPT RES.,VAR.1K OHM | VR101 |
| 80-161-37 | PPT RES.,VAR.100K-B | R221 |
| 80-161-38 | PPT RES.,VAR.100K-B | VR303 |
| 80-161-39 | PPT RES.,VAR.200K-B | VR202,301,302 |
| 80-161-40 | PPT RES.,VAR.2MEG-B | VR201 |
| 80-161-43 | PPT RES.,VAR.500 OHM | VR401 |
| 80-161-46 | PPT RES.,VAR.100K-A | VR203 |
| 80-163-03 | PPT THERMISTOR SG-15 5OHM 1A | TR101 |
| 80-900-00 | PPT RES, CF 100 OHM 1/4W 5% | R402 |
| 80-900-02 | PPT RES, CF 470 OHM 1/4W 5% | R201,407 |
| 80-900-04 | PPT RES, CF 680 OHM 1/4W 5% | R403 |
| 80-900-05 | PPT RES, CF 1K OHM 1/4W 5% | R112,R13,R3 R6,R7,R8 |
| 80-900-08 | PPT RES, CF 10K OHM 1/4W 5% | R1,R223,R301 |
| 80-900-11 | PPT RES, CF 3.3 OHM 1/4W 5% | R311 |
| 80-900-12 | PPT RES, CF 47 OHM 1/4W 5% | R404,R406,R410 |
| 80-900-13 | PPT RES, CF 68 OHM 1/4W 5% | R106,R4 |
| 80-900-14 | PPT RES, CF 220 OHM 1/4W 5% | R409 |
| 80-900-15 | PPT RES, CF 1.5K OHM 1/4W 5% | R109 |
| 80-900-17 | PPT RES, CF 39K OHM 1/4W 5% | R305 |
| 80-900-19 | PPT RES, CF 56K OHM 1/4W 5% | R307,R310 |

Table 5-1 Continued

| Part Number | Description | Location |
|---|---|---|
| **Resistors (continued)** | | |
| 80-900-20 | PPT RES, CF 68K OHM 1/4W 5% | R225,R309 |
| 80-900-21 | PPT RES, CF 150K OHM 1/4W 5% | R218,R303 |
| 80-900-22 | PPT RES, CF 270K OHM 1/4W 5% | R304 |
| 80-900-23 | PPT RES, CF 470K OHM 1/4W 5% | R306 |
| 80-900-24 | PPT RES, CF 12K OHM 1/4W 5% | R108 |
| 80-900-31 | PPT RES, CF 4.7K OHM 1/4W 5% | R107,R12,R14 R15,R16 |
| 80-900-33 | PPT RES, CF 120K OHM 1/4W 5% | R219 |
| 80-900-35 | PPT RES, CF 100K OHM 1/4W 5% | R214 |
| 80-900-37 | PPT RES, CF 82 OHM 1/4W 5% | R313 |
| 80-900-39 | PPT RES, CF 2.2K OHM 1/4W 5% | R10,R11,R2,R9 |
| 80-900-46 | PPT RES, CF 22K OHM 1/4W 5% | R220 |
| 80-900-58 | PPT RES, CF 1MEG, 1/4W 5% | R215 |
| 80-900-65 | PPT RES, CF 220K OHM 1/4W 5% | R312 |
| 80-900-69 | PPT RES, CF 62 OHM 1/4W 5% | R405 |
| 80-900-89 | PPT RES, CF 15K OHM 1/4W 5% | R110 |
| 80-900-90 | PPT RES, CF 33 OHM 1/4W 5% | R104,R5 |
| 80-900-93 | PPT RES, CF 10 OHM 1/4W 5% | R22,R23,R24,R25 R26,R27,R28,R29 |
| 80-901-04 | PPT RES, CF 57 OHM 1/4W 5% | R202 |
| 80-901-50 | PPT RES, CF 180K OHM 1/4W 5% | R302 |
| 80-901-63 | PPT RES, MOF 12 OHM 2W 5% | R113 |
| 80-901-69 | PPT RES, WW 1.5 OHM 3W 5% | R105 |
| 80-901-71 | PPT RES, MOF 1K OHM 2W 5% | R408 |
| 80-901-76 | PPT RES, CF 330K 1W 5% | R101 |
| 80-904-03 | PPT RES, CF 120K OHM 1/2W 5% | R114,R115 |
| 80-904-15 | PPT RES, CF 1 OHM 1/2W 5% | R308 |
| 80-904-42 | PPT RES, CF 3K OHM 1/4W 5% | R222 |
| 80-904-50 | PPT RES, CF 10 OHM 1/2W 5% | R224 |
| 80-905-43 | PPT RES, MOF 33 OHM 1W 5% | R102,R203 |
| 80-905-64 | PPT RES, CF 220K OHM 1/2W 5% | R216,R217 |
| 80-905-66 | PPT RES, MOF 560 OHM 1W 5% | R204 |
| 80-905-69 | PPT RES, MOF 1K OHM 5W 5% | R103 |
| **Crystals, Coils, Diodes, Transistors** | | |
| 410009-01 | PPT COIL, HOR. WIDTH | L202 |
| 410010-01 | PPT COIL, HOR. LINERARITY | L203 |
| 410011-01 | PPT COIL, DYNAMIC FOCUS | L204 |
| 80-006-06 | PPT COIL, 10UH CHOKE | L104 |
| 80-170-01 | PPT DIODE, IN914B | D1,D2,D403 |
| 80-170-19 | PPT DIODE, VO9C | D205,D206,D301 |
| 80-170-24 | PPT DIODE, RGP5020 | D105 |
| 80-170-25 | PPT DIODE, RGP30G | D108 |
| 80-170-43 | PPT DIODE, IN4937 1A/600V | D106,D110 |
| 80-170-44 | PPT DIODE, IN4004 1A/400V | D107 |
| 80-170-47 | PPT DIODE, SB 350 3A/50V | D109 |
| 80-170-55 | PPT DIODE, IN747A | D3 |
| 80-170-66 | PPT DIODE, V19E | D202 |

Table 5-1 Continued

| Part Number | Description | Location |
|---|---|---|
| **Crystals, Coils, Diodes, Transistors (continued)** | | |
| 80-170-67 | PPT DIODE, V11N | D203 |
| 80-170-68 | PPT DIODE, 1S2076 | D401 |
| 80-170-69 | PPT DIODE, ZENER HZ6C2 | D402,Z1,Z2,Z3 |
| 80-170-78 | PPT DIODE, 1N5397 | D101,D102,D103 D104 |
| 80-170-79 | PPT DIODE, U19C | D201 |
| 80-170-80 | PPT DIODE, ZENER HZ3B2 | D404 |
| 80-180-02 | PPT TRANSISTOR, 2N2222 | Q102,Q403 |
| 80-180-04 | PPT TRANSISTOR, 2N2906 | Q1 |
| 80-180-06 | PPT TRANSISTOR, 2N2369 | Q401 |
| 80-180-07 | PPT TRANSISTOR, BU406 | Q202 |
| 80-180-25 | PPT TRANSISTOR, 2SC3150 | Q101 |
| 80-180-48 | PPT TRANSISTOR, 2SC1213 | Q201 |
| 80-180-65 | PPT TRANSISTOR, BSX-32 | Q402 |
| 80-180-46 | PPT TRANSISTOR, BSX-59 | SUB |
| 80-190-05 | PPT LED, 5219 | DS1 |
| 80-600-25 | PPT COIL, CHOKE 10UH 1.5A | L102,L103 |
| 80-690-23 | PPT CRYSTAL, 19.6614MHZ HC18/W | X1 |
| **Capacitors** | | |
| 80-920-04 | PPT CAP., CD .01MF 1KV | C210 |
| 80-920-09 | PPT CAP., CD .001MF 50V | C204 |
| 80-920-11 | PPT CAP., MG .1MF 50V AXIAL | C8,C9,C10,C11,C12 C120,C121,C122, C123,C124,C125, C13,C14,C19,C216, C24,C25,C26,C27, C3,C30,C31,C32, C33,C36,C41,C6,C7 |
| 80-920-25 | PPT CAP., CD 1000PF 500V | C215 |
| 80-920-29 | PPT CAP., MG 220PF 50V (AXIAL) | C15,C16,C17,C18 C20,C21,C22,C23 |
| 80-920-34 | PPT CAP., CD 680PF 50V | C305,C308 |
| 80-920-36 | PPT CAP., 22PF AXIAL 50V | C34,C35,C40,C42, C43 |
| 80-920-47 | PPT CAP., MG 330PF 50V K | C29 |
| 80-920-54 | PPT CAP., MPF .22MF 100V | C111 |
| 80-920-92 | PPT CAP., CD 560PF 1KV K Y5P | C109 |
| 80-920-93 | PPT CAP., CD 330PF 500V K Y5P | C207 |
| 80-920-94 | PPT CAP., CD 1000PF 1KV Z | C214 |
| 80-920-98 | PPT CAP., CD 100PF 50V K Y5P | C301 |
| 80-930-00 | PPT CAP., AEL 10MF 16V | C1 |
| 80-930-01 | PPT CAP., AEL 47MF 25V VT. MNT. | C108,C2 |
| 80-930-04 | PPT CAP., AEL 220MF 25V | C116,C117,C209 |
| 80-930-11 | PPT CAP., AEL 10UF 25V VT. MNT. | C110,C306 |
| 80-930-21 | PPT CAP., AEL 1MF 50V | C202 |
| 80-930-22 | PPT CAP., AEL 10MF 160V | C212 |
| 80-930-42 | PPT CAP., AEL 470MF 16V VT. MNT. | C208 |

Table 5-1 Continued

| Part Number | Description | Location |
|---|---|---|
| **Capacitors (continued)** | | |
| 80-930-43 | PPT CAP., AEL 1000MF 16V VT. MNT. | C310 |
| 80-930-51 | PPT CAP., AEL 2200MF 16V | C112,C113 |
| 80-930-58 | PPT CAP., AEL 100MF 16V | C37,C39 |
| 80-930-82 | PPT CAP., AEL 100MF 16V | C309,C311 |
| 80-930-84 | PPT CAP., AEL 100MF 63V | C211 |
| 80-930-86 | PPT CAP., AEL 220MF 200V | C105,C106 |
| 80-930-89 | PPT CAP., AEL 2200UF 10V, 85 DEGREE C | C114,C115 |
| 80-930-92 | PPT CAP., AEL 6.8UF 35V | C205 |
| 80-940-06 | PPT CAP., MPF .39MFD 100V | C4 |
| 80-940-17 | PPT CAP., PPN .022MFD 400V | C203 |
| 80-940-19 | PPT CAP., MPF .1MFD 100V | C107,C302,C303 C304,C307 |
| 80-940-30 | PPT CAP., PPN .018MF 630V 5% | C213 |
| 80-940-49 | PPT CAP., PEE .22MF 50V 5% | C201,C401 |
| 80-940-66 | PPT CAP., PPN .22UF 630V J | C206 |
| 80-940-67 | PPT CAP., PEE .22UF 100V K | C118 |
| 80-950-02 | PPT CAP., MICA 56PF | C5 |
| 80-960-01 | PPT CAP., INTERF. SUPP., .47MFD 250VAC | C101 |
| 80-960-02 | PPT CAP., INTERF. SUPP., .1MFD/250VAC | C104 |
| 80-960-03 | PPT CAP., .0047MFD 250VAC-Y PME271YA4L470M FIF | C102,C103 |
| 80-960-20 | PPT CAP., MG 1000PF/50V KX7R | C28 |
| 80-960-25 | PPT CAP., MK 200PF 50V J NPO | C402 |
| **Transformers** | | |
| 4200028-01 | PWR TRANSFORMER EI-40 | T101 |
| 4200029-01 | DRIVE TRANSFORMER | T102 |
| 4200030-01 | HOR. DRIVE TRANSFORMER | TL01 |
| 4200031-01 | FLYBACK | T202 |
| 680002-01 | LINE FILTER, COMMON CHOKE 18MH | L101 |

**Table 5-2 Keyboard Components List**

| Part Number | Description | Location |
|---|---|---|
| 80-170-01 | PPT DIODE, IN914B | D1,D2,D3,D4 |
| 80-170-69 | PPT DIODE, ZENER HZ6C2 | D5 |
| 80-435-13 | PPT IC KEYBOARD GATE ARRAY | U1 |
| 80-900-39 | PPT RES, CF 2.2K OHM 1/4W 5% | R1 |
| 80-900-93 | PPT RES, CF 10 OHM 1/4W 5% | R3,R4,R5,R6 |
| 80-904-47 | PPT RES, CF 24K OHM 1/4W 5% | R2 |
| 80-920-11 | PPT CAP., MG .1MF 50V AXIAL | C3 |
| 80-930-35 | PPT CAP., AEL 470MF 6.3V | C1 |
| 80-960-05 | PPT CAP., MG .0015MF 50V K X7R | C2 |

Figure 5-3 Terminal Board Assembly Layout

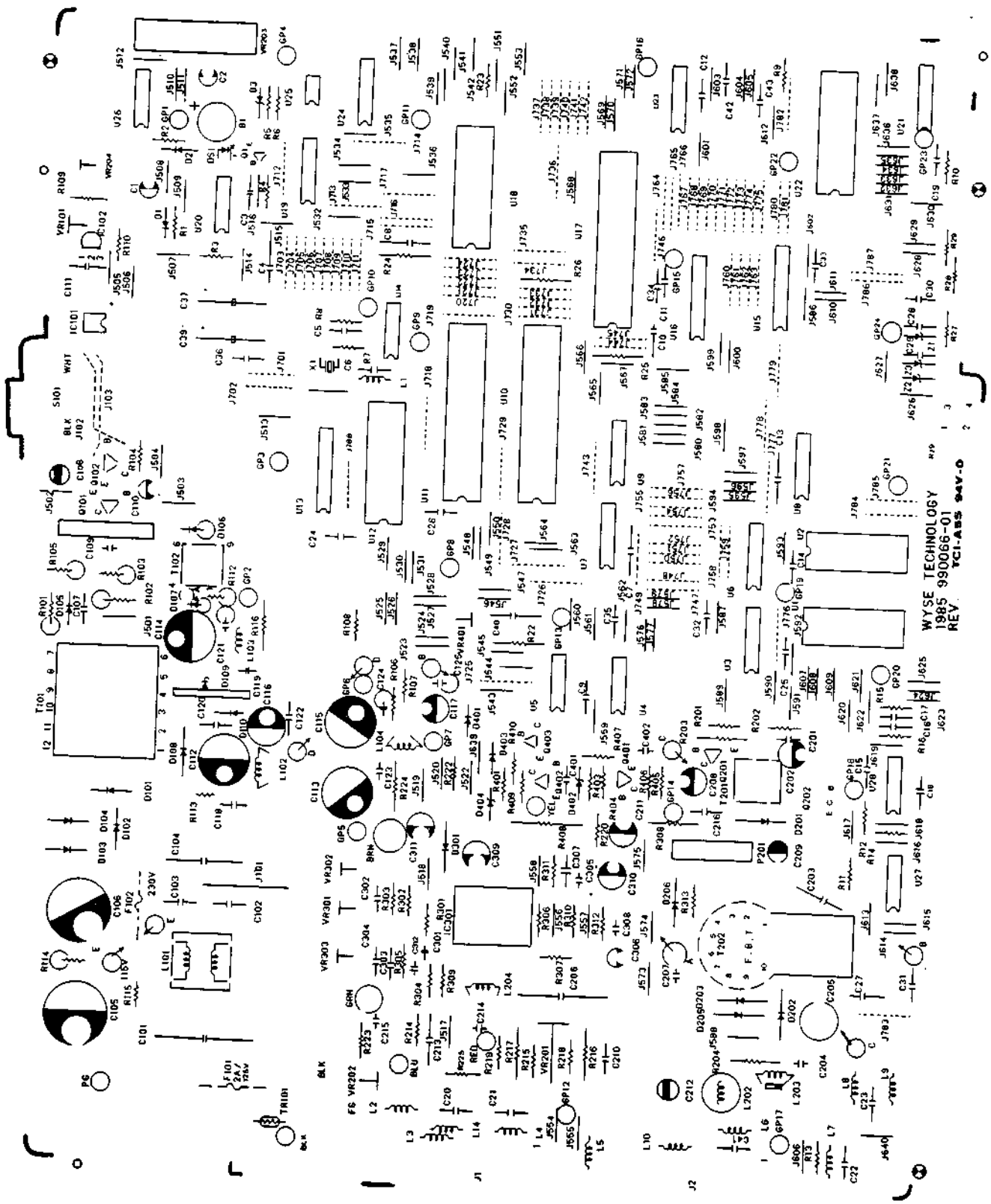


**Table 5-3 Diagnostic Self-Test Connectors**

| Part | Part Number |
|---|---|
| Connector set | 940268-01 |
| MODEM port connector | 940270-01 |
| AUX port connector | 940267-01 |

# 6 THEORY OF OPERATION


Introduction ..... 6-2

Microcomputer and Related Logic ..... 6-2
- Microcomputer ..... 6-2
  - Interrupt Vectors ..... 6-3
  - Direct Addressing Mode ..... 6-3
  - Input/Output Considerations ..... 6-3
  - Memory Limitations ..... 6-6
- Video Interface and Synchronization ..... 6-7
  - 6845 CRT Controller Parameters ..... 6-7
  - Video Interrupt ..... 6-8
  - Character Attributes ..... 6-9
- Video Character Data ..... 6-9
- Screen Attributes ..... 6-10
- Input/Output Devices ..... 6-10

Power Supply and Monitor Circuitry ..... 6-10
- Power Supply ..... 6-11
- Circuit Protection ..... 6-11
- Display Monitor Circuitry ..... 6-11
  - Vertical Deflection ..... 6-12
  - Horizontal Deflection ..... 6-12
  - Focus and Brightness Circuits ..... 6-13
  - Video Amplification ..... 6-13

Keyboard ..... 6-13

Communication Ports ..... 6-13

Terms and Abbreviations ..... 6-13

## INTRODUCTION

This chapter explains the terminal's operation and can be used in conjunction with the schematics in Chapter 7. The section "Terms and Abbreviations" at the end of this chapter introduces terms with which you may not be familiar and describes new concepts. If you are an inexperienced technician, and haven't encountered these concepts, you may want to read this section first.

We have organized this chapter into five sections: microcomputer and related logic, monitor, power supply, keyboard, and communications ports. You may read them in sequence or refer to sections as you need them.

## MICROCOMPUTER AND RELATED LOGIC

The terminal logic contains three major functional areas: the microcomputer, video interface and synchronization, and I/O devices. The following sections describe the functions of each group.

### Microcomputer

The CPU is a complete microcomputer that runs terminal firmware. The firmware, permanently stored in ROM, controls the terminal. Functions of this firmware include scanning the keyboard, controlling the video circuitry, transferring data to and from the serial ports, and performing data-manipulation tasks such as inserting or deleting data from the text shown on the screen.

The terminal's microcomputer is built around the 2 megahertz version of the 6800 CPU, the 68B00. The microcomputer is the combination of this CPU, together with several other components: a two-phase clock, program memory, 4K of RAM, and a reset circuit. The synchronization circuit generates the two-phase clock circuit. The program memory is 8K of ROM. The RAM, used by the microprocessor for variable storage and system stack, is shared with the video interface as screen refresh. The reset circuit generates a system reset whenever it detects a low-power condition.

**Memory Limitations**--The 6800 can address 64K of memory. If more memory is needed, then a page-select scheme is used. When the extended ROM page is used on this terminal, then all of the interrupt vectors and interrupt routines are duplicated in the extended page. It is not necessary to duplicate the reset vector or routine, since a reset will automatically select the main ROM page.

Figure 6-1 shows the terminal memory map.

## Figure 6-1 Memory Map

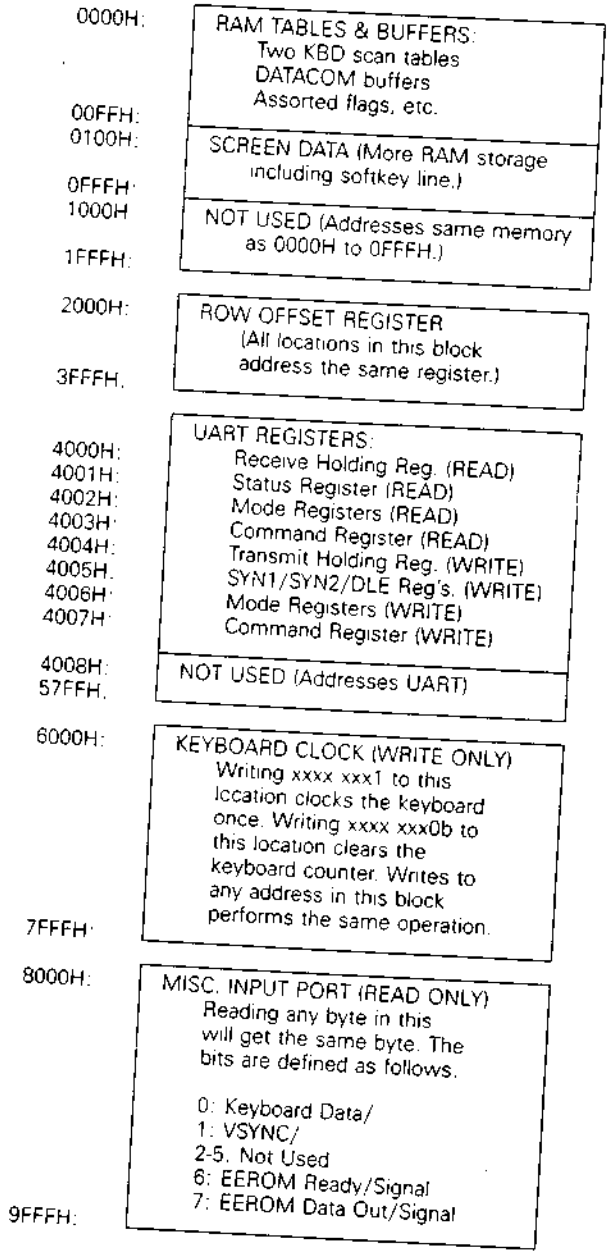
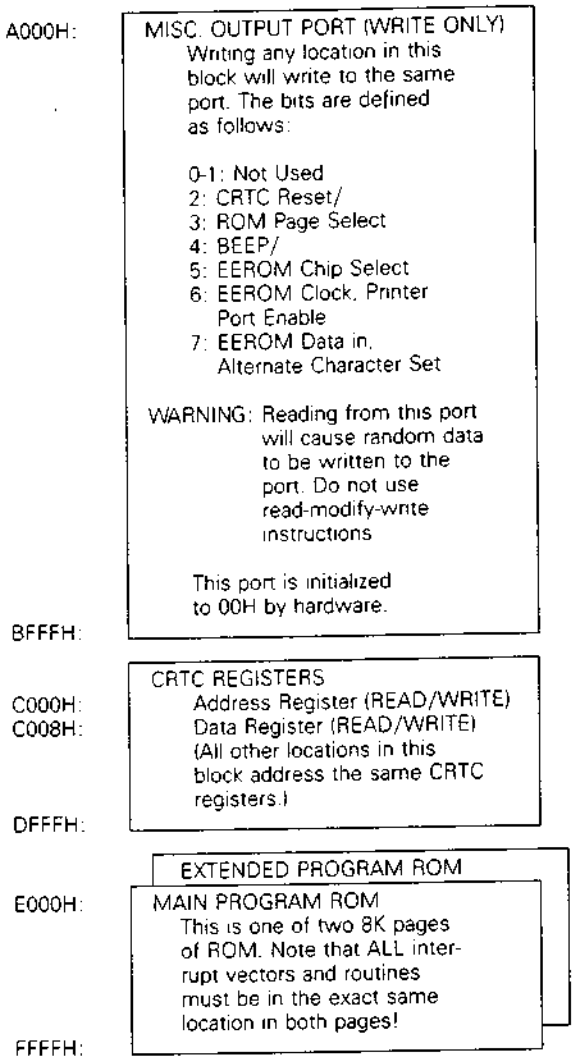


**Figure 6-1 Continued**




## Video Interface and Synchronization

The video interface includes both the CRT controller (CRTC) and the video attribute and dot logic. The video interface is completely synchronized with the CPU. This eliminates the need for a row buffer, while allowing the CPU and the CRTC to have unrestricted access to the screen-refresh RAM. (The synchronization circuitry is part of the video interface.)

The terminal video interface is designed around the two megahertz version of the 6845 CRTC (the 68B45) and a custom video gate array. This gate array performs many functions, including synchronizing the CPU with the CRTC. These functions are listed below:

- Generation of CPU and CRTC clocks as a function of the dot clock

- Character attribute decode and generation
- Screen-refresh RAM address multiplexor control
- Screen attribute decode and generation
- Combined video and attribute serialization
- Horizontal sync pulse stretch
- UART clock generation
- Generation of a CPU interrupt at the beginning of each character row

The address outputs of the CRTC are modified by the contents of the row offset register using a pair of adders. The row offset register is reloaded at the beginning of each character row, so the CRTC can address nonsequencial character rows (indirect row addressing).

The modified address from the CRTC selects the next data byte to be displayed on the screen from the screen refresh RAM. This address is sent to the refresh RAM through the address MUX, which alternately allows the CRTC and the CPU to address the RAM. The terminal has 4K of display RAM, which is shared by the CPU.

Character data from the screen display RAM moves directly into the gate array for attribute decoding. It simultaneously goes to the character latch. The character latch, together with the pixel row number from the gate array, selects a row of pixels to be displayed from the character generator. The character generator is a ROM that contains pixel patterns for each displayable character, whose outputs go back to the gate array to be displayed on the screen.

**68B45 CRT Controller Parameters**--These are the 68B45 CRT controller display parameters:

| | |
|---|---|
| Vertical frequency | 60.00 Hz (frames/second) |
| Horizontal frequency | 19.86 KHz (lines/second) |
| Video dot frequency | 19.66 MHz (dots/second) |
| Character (& CPU) clock | 1.966 MHz (characters/second |
| Vertical retrace time | 0.957 mSec (19 lines) |
| Horizontal retrace time | 9.664 uSec (19 characters) |
| Horizontal sync pulse | 16.79 uSec (33 characters) |
| Vertical sync pulse | 805.64 uSec (16 lines) |
| Display size | 26 rows of 80 characters |
| Character cell size | 12 lines of 10 dots |

The gate array adds 32 character times (16.28 mSec) to the programmed horizontal sync pulse, so the CRTC Sync Width Register must be programmed with 33-32=1. The gate array also generates the horizontal sync pulse one character interval early. Table 6 gives the values loaded into the CRTC.

**Table 6-2 Values Loaded into CRTC**

| Register Number | Register File | Value |
|---|---|---|
| R0 | Horizontal total | 62h |
| R1 | Horizontal displayed | 50h |
| R2 | Horizontal sync position | 51h |
| R3 | Sync width | 01h |
| R4 | Vertical total | 1Ah |
| R5 | Vertical total adjust | 07h |
| R6 | Vertical displayed | 1Ah |
| R7 | Vertical sync position | 1Ah |
| R8 | Interlace mode and skew | 00h |
| R9 | Max scan line address | 0Bh |
| R10 | Cursor start | 0 (block style)<br>0Ah (line style) |
| R11 | Cursor end | 0Bh |

R10 and R12-R15 will change during program execution. R16 and R17 are light pen registers and are ignored.

**Video Interrupt**--The video interrupt is a nonmaskable interrupt (NMI) that occurs at the beginning of each scan line 0. Note that if one scan line 0 follows immediately after another scan line 0 (for instance, in smooth scrolling), then no interrupt will occur at the beginning of the second scan line 0. Whenever the CRTC is enabled, this interrupt occurs. The purpose of the interrupt is to allow the processor to change the row address of each row before it is displayed, allowing indirect row addressing. When this interrupt occurs, the processor has the length of time of 12 scan lines (604 mSec) to load the row offset register with the offset value for the next row.

**Note**--The 8-bit value loaded into the row offset register is added to bits 4 through 11 of the 12-bit address produced by the CRTC. This indicates three operating conditions:

- Rows must begin at an even 16-byte boundary.
- The row offset register must be loaded with the position of the row in memory relative to the position of that row on the screen.
- Negative values of row offset are expressed in two's compliment form.

**Character Attributes**--The gate array generates all the terminal's video attributes. There are two types of attributes available to the terminal: hidden and serial attributes. Each character displayed on the screen is represented by eight bits of RAM. If the high three bits are 100, the CPU assumes the character is a nonhidden attribute, which causes two actions--a blank cell is displayed and the attribute value stored in the low five bits is loaded into the serial attribute latches within the gate array.

If the high order bit is 1 and the next two bits are not 00, then the character is displayed with the hidden attribute specified by the screen attribute byte. Any other combination of attribute bits is displayed with no attribute or the currently loaded serial attribute. Table 6-3 shows the attribute assignments.

**Table 6-3 Screen Attribute Assignments**

000xxxxx Graphics character (cannot be displayed with hidden attribute)

100RUSBD = Serial attribute:

R = Reverse (inverts video)
U = Underline (places underline at scan line 9)
S = Security (or blank--blanks only video dots)
B = Blink (blinks video dots and underline)
D = Dim (dims video)

Attributes are combined using the following Boolean function:

V = Output of video shift register
C = Cursor
E = Display enabled (not retracing)
L = Scan line 11 (last scan line)
N = Nonhidden (serial) attribute
O = Output of blink oscillator
BL = O AND B
UL = U AND L

$$VIDEO = E \text{ AND } (\overline{N} \text{ AND } (\overline{BL} \text{ AND } (\overline{S} \text{ AND } V) \text{ OR } UL) \text{ XOR } R) \text{ XOR } C)$$

$$DIM = E \text{ AND } \overline{N} \text{ AND } D$$

**Video Character Data**

The video character data is generated by the character generator, and sent to the gate array. This data is combined with the attribute data and appears as serial data at the VIDEO pin. Bit 7 appears first (on the left), followed by bits 6 through 0. Bit 0 is displayed twice in a row at the right side of the current character cell, and is displayed as the first (leftmost) dot of the next character cell. Each character cell is 10 dots wide.

**Screen Attributes**

There are nine attributes that, when set, apply to the whole screen. These are true reverse and alternate attribute (ATM), screen blank, and six protect modes.

- True reverse inverts the screen display.

- ATM changes the manner in which serial attributes are terminated. If ATM is off, then a serial attribute is terminated only by another serial attribute. This means that the screen must contain at least one serial attribute somewhere, so that the serial attributes are defined. The firmware always places an attribute at the beginning and end of the status line. If ATM is on, then serial attributes are terminated by either another serial attribute, or by the end of the character row, which ever comes first.

- Screen blank blanks the screen.

- The six protect modes are dim, double wide, reverse, underline, blink and blank. These protect mode bits can be combined to allow a total of 32.

The screen attributes are controlled by the **screen attribute byte** (SAB). The SAB is the first byte of both of the two character rows of vertical blanking. It is sufficient to set the first byte of the first vertical blanking row to 0, and to set the first byte of the second blanking row to contain the current screen attributes. The bits within the SAB are assigned as follows:

| **Bit Position** | **Function** |
|---|---|
| 7 | Protect = double wide |
| 6 | Alternate attribute mode (ATM) |
| 5 | True reverse |
| 4 | Protect = reverse |
| 3 | Protect = underline |
| 2 | Protect = blank |
| 1 | Protect = blink |
| 0 | Protect = dim |

**Note**--If both **Protect = Blink** and **Protect = Blank** are selected, the entire screen is blanked.

### Input/Output Devices

I/O devices for the 6800 CPU are specialized memory locations; the same instructions that manipulate memory manipulate the 6800 I/O devices. There are two I/O devices in the CRTC circuitry of the previous section--the 68B45 itself, with several control registers, and the row offset register. In addition to the 68B45 and the row offset register, there are several more I/O devices:

- The UART, which controls both serial ports (modem and AUX)

- The beeper, which is turned on and off by the CPU

- The keyboard, which is scanned through a special serial link

- EEROM, which is written to and read from through a serial interface

## POWER SUPPLY AND MONITOR CIRCUITRY

The following paragraphs describe the power supply and monitor circuitry on the terminal PCB. You may want to look at the schematics in Chapter 7 as you read the following descriptions.

### Power Supply

When the terminal receives power, coil (L101) filters incoming AC line voltage, then transistor TR101 reduces the surge current. If the load is too great, line fuse F101 opens. Jack J102 selects either 115 volt or 230 volt operation. When operating with 115 volts, J102 enables the voltage doubling circuit to provide the DC/AC converter with the nominal 320 VDC it needs to operate.

Diodes D101, D102, D103, and D104 form the bridge diode network that rectifies the incoming current. Energy is stored in the primary winding of switching transformer T101 when transistor Q101 is turned on. This stored energy is transferred to the secondary windings when Q101 is turned off. Q102 conducts alternately on the half-cycle, storing energy in the primary winding.

When receiving power, the free-running switching rate is approximately 20 kHz. Transformer T102 synchronizes the 19.8 kHz horizontal sweep rate with the switching rate to reduce the noise that high-frequency generates. The flyback transformer, T202, generates the horizontal sweep rate when it receives the horizontal sync signal from the CRT controller chip.

The secondary windings provide three voltage taps: 54 VAC, 24 VAC, and 48 VAC.

54 VAC is half-wave rectified by D108, smoothed by LC network L102 and C125, and filtered by C120 and C113 to produce +12V.

24 VAC is half-wave rectified by D109, smoothed by LC network L103 and C124, and filtered by C121, C114, and C115 to produce +5V.

48 VAC is half-wave rectified by D110, smoothed by LC network L104 and C125, and filtered by C122, C116, and C117 to produce -12V.

A feedback loop through IC101 regulates all three voltages. This opto-isolated coupler senses and samples a fraction of the +5V and +12V output. The +5V tap drives the logic and must be tightly controlled. As the primary DC voltage decreases, or as load current increases, the voltage change at the output of IC101 extends the width of the "on" time of each half cycle. In a similar fashion, a primary DC voltage increase or a load current decrease will cause a decrease in the width of the "on" time, producing a constant voltage at the output point.

VR101 is the only power supply adjustment. Since the +5V output is sampled for feedback to the primary side, adjusting VR101 affects all three outputs.

### Circuit Protection

Q101, Q102, R104, and R105 protect against overload and short-circuit conditions. As the primary currentincreases, the base current of Q102 increases, turning off Q101 and the output.

The IC102 crowbar circuit protects from overvoltage problems. When the threshold voltage is exceeded, the gate fires, and the +5V output is shorted to ground. This open circuit action protects sensitive components on the +5V power bus.

### Display Monitor Circuitry

The display monitor circuitry contains vertical deflection, horizontal deflection, focus and brightness circuits, and video amplification circuitry.

**Vertical Deflection**--The vertical deflection circuit contains IC301 and additional discrete components. The +12V supply applied to pin 2 drives the internal oscillator. The oscillator frequency depends on the charging time constant of C302, R302 and VR301. Adjusting VR301 (vertical hold) synchronizes the vertical synchronization input at pin 8 with the oscillator.

Vertical Size, VR202, controls the amplitude of the internal vertical RAM generator. Adjusting VR202 affects the pin 4 output, which changes the vertical dimension of the raster.

To obtain sufficiently short flyback times, the internal flyback generator doubles the input voltage at pin 5, applying it to the vertical yoke through the power amplifier.

The ramp curve produced by C303, C304, R304, R305, and the internal buffer stage results in a high degree of linearity. VR303 adjusts vertical linearity.

**Horizontal Deflection**--Horizontal deflection contains these main circuits and components: the horizontal driver circuit, the horizontal output circuit, the flyback transformer, and the linearity modulating coil.

The horizontal driver applies the horizontal synchronization signal from the logic to the base of Q201 through R201 where it is amplified and inverted. Current flows through the primary winding of T201 from the 12V bias through R203 while Q201 conducts to saturation. The energy is passed onto the secondary of T201 when Q201 turns off, turning Q202 on. C201 and R202 protect Q201 by absorbing the inductive spikes from the switching action.

Horizontal output transistor Q202 and damping diode D202 act as the switches in this switching circuit. The net effect of: (a) the switching action of transistor Q202; (b) the damping action of D202; and (c) the large time constant offered by the inductive reactance of the horizontal deflection coil is a sawtooth waveform through the deflection coil.

The flyback transformer, T202, sends signals and voltages to various stages of the horizontal output circuit and the power supply switching synchronization. The secondary taps provide 50V for the video output stage, -100V for brightness control grid, and 600V for the focus grid. T202 also generates the anode high voltage of 13 to 14kV.

The linearity modulating coil, L202, causes the beam to sweep across the screen at a constant rate, compensating for time constant produced by resistive elements in the circuit. If the beam travels across the screen at a constant rate, characters displayed at the center of the screen appear narrower than those displayed at the edges. "S" curve correction capacitor C205 is connected in series with the deflection yoke to match the curvature of the CRT. The result is uniformity of character width across the screen.

**Focus and Brightness Circuits**--The focus and brightness circuits contain the following components and controls:

Focus is controled by static focus control VR201. The signal for the horizontal dynamic focus is picked up from damping diode D202, boosted through C206 and L204 and applied to the focus grid together with the static focus voltage.

Brightness and sub-brightness controls VR203 and VR202 are connected to the -100V output of the flyback, the 12V bias, and the brightness grid. Brightness adjustments are VR203, VR202, and the brightness slideswitch.

**Video Amplification**--Q405, D403, D404, and R410 clamp the VIDEO signal from the video logic circuit. Both the VIDEO and DIM signals are applied to the base of Q401. VR401 adjusts the balance between the two signals. D401 prevents interference from the VIDEO signal during DIM adjusment. Q401 and Q402 are the cascade amplifier which amplifies the input signal to drive the CRT. C402 and R406 form an emitter peaking circuit. The +12V supply generates the heater voltage through R224.

## KEYBOARD

The keyboard is scanned by a keyscanning integrated circuit (IC). This IC contains a scanner that addresses a different key for each of the counter's values. A long clock (>30 usec) pulse clears the counter. A short clock pulse (<6 usec) increments the counter to address the next key. The scanner communicates with the terminal through the keyboard's four-wire interface.

The line from the keyboard to the processor gives the status of the key currently being addressed.

The processor in the terminal is connected to this keyboard with a special port. Writing a one to this port causes a short low pulse to be sent to the keyboard. Writing a zero to this port causes a constant low level to be sent to the keyboard. Note that the first one sent to the port following a zero will not increment the keyboard counter; it only terminates the constant low level caused by the previous zero.

## COMMUNICATION PORTS

The terminal has two ports, the MODEM and AUX (printer) ports. Both ports are controlled by a Signetics SCN2661 UART, which is switched by an output bit as shown in the memory map (p. 6-x). Since the UART serves two ports, both ports run at the same baud rate. The clock source for the UART comes from the gate array. This clock is equal to the dot clock divided by four, or 4.915 MHz.

The MODEM port accepts standard modem handshaking signals ($\overline{TxD}$, $\overline{RxD}$, RTS, CTS, DCD). The AUX (printer) port sends only one output, $\overline{RxD}$, and one input, DTR. The input connects with the DSR input of the UART. The unused outputs (CTS, DSR, DCD) are tied high (active) with a 1K resistor to +12 volts. The DTR input is connected to two pins (pin 20 = DTR and pin 11 = PRDY), to allow connection to both Epson-style and Oki-style printers.

## TERMS AND ABBREVIATIONS

This section introduces the terms and abbreviations found throughout the theory of operation. They are listed in alphabetical order, so you can used the list as a quick reference.

| | |
|---|---|
| AUX port | Auxillary output port, intended to connect to a printer. |
| Baud rate | The rate of speed at which data is transmitted (or received) by a serial port. The units of baud rate are bits per second. |
| Bit | Binary digit. This can be either a 1 or a 0. In digital terminal circuits, a 1 is represented by a voltage between 2.5 V and 5 V and a 0 is represented by a voltage between 0 V and 0.75 V. |
| Byte | An 8-bit binary number. |
| CPU | Central processing unit. The terminal CPU is a 68B00 microprocessor. |
| CRT | Cathode ray tube. This is the terminal display screen. |

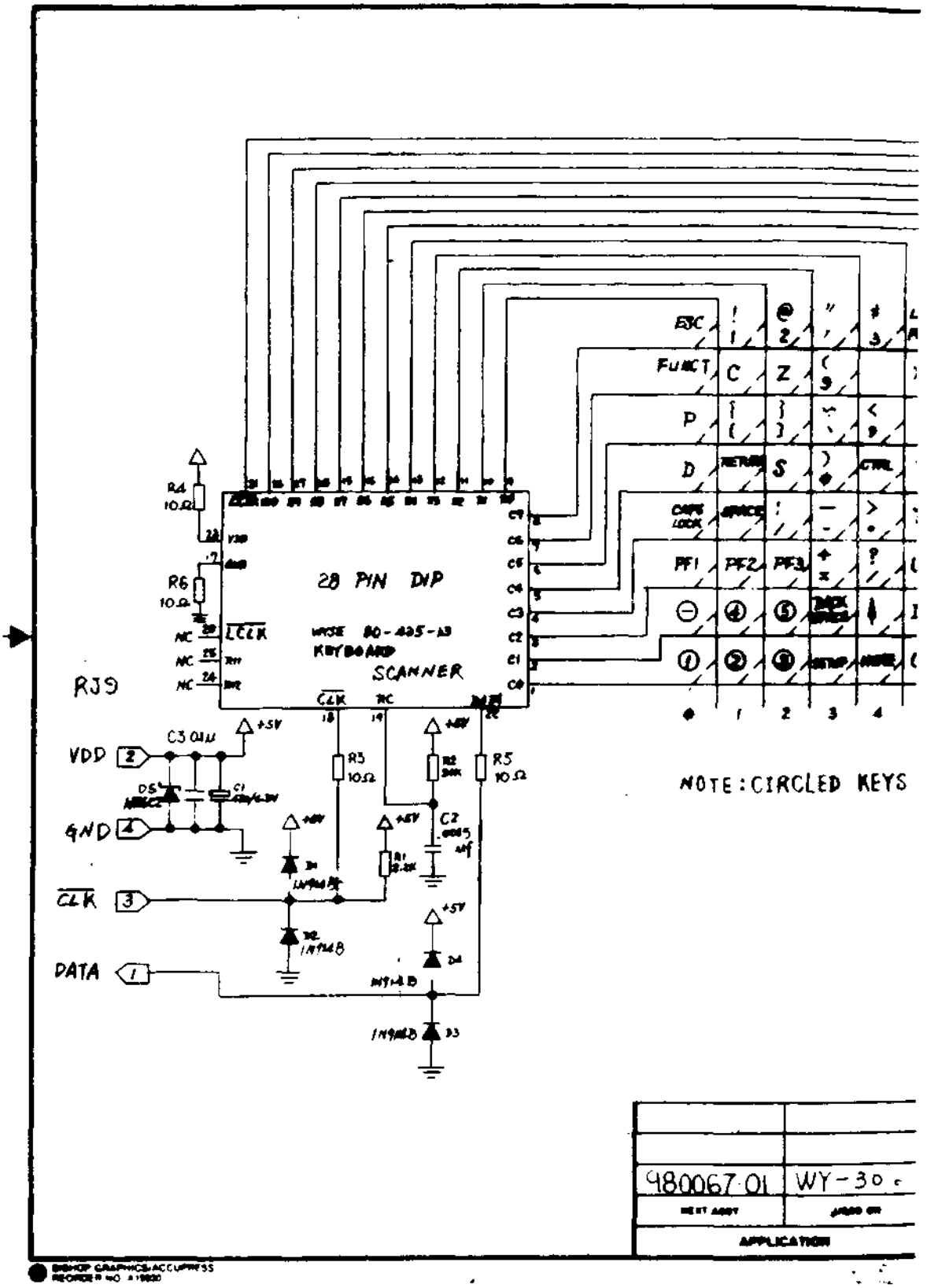
| | |
|---|---|
| CRTC | CRT controller integrated circuit. The terminal uses a 68B45 CRTC. |
| EEROM | Electrically erasable read-only memory. The terminal uses an ER5911 EEROM as its nonvolatile storage. |
| I/O | Input/output. |
| MODEM port | The terminal's main communication port. It can be connected to a modem, a computer, or any other compatible device. |
| MUX | Multiplexer. This device selects data from one of two sources. |
| Pixel | Picture element. This is the basic unit of a raster display. It appears as a dot on the screen. |
| RAM | Random-access memory. This device contains display data, communication buffers, and all other changeable data. All data in RAM is lost when the power is turned off. |
| ROM | Read-only memory. The terminal's program memory and character generator are ROM. (This data isn't lost when the power is turned off.) |
| UART | Universal asynchronous receiver transmitter. This device converts parallel data to and from the serial encoding format used by the MODEM and AUX ports. The terminal uses a 2661 UART. |

# 7 SCHEMATICS


| Schematic | Part | Figure | Page |
|---|---|---|---|
| Keyboard PCB | 960067-01 | 7-1 | 7-3 |
| Terminal PCB (Logic) | 960066-01 | 7-2 | 7-5 |
| Terminal PCB (Monitor/Power Supply) | 960066-01 | 7-3 | 7-7 |

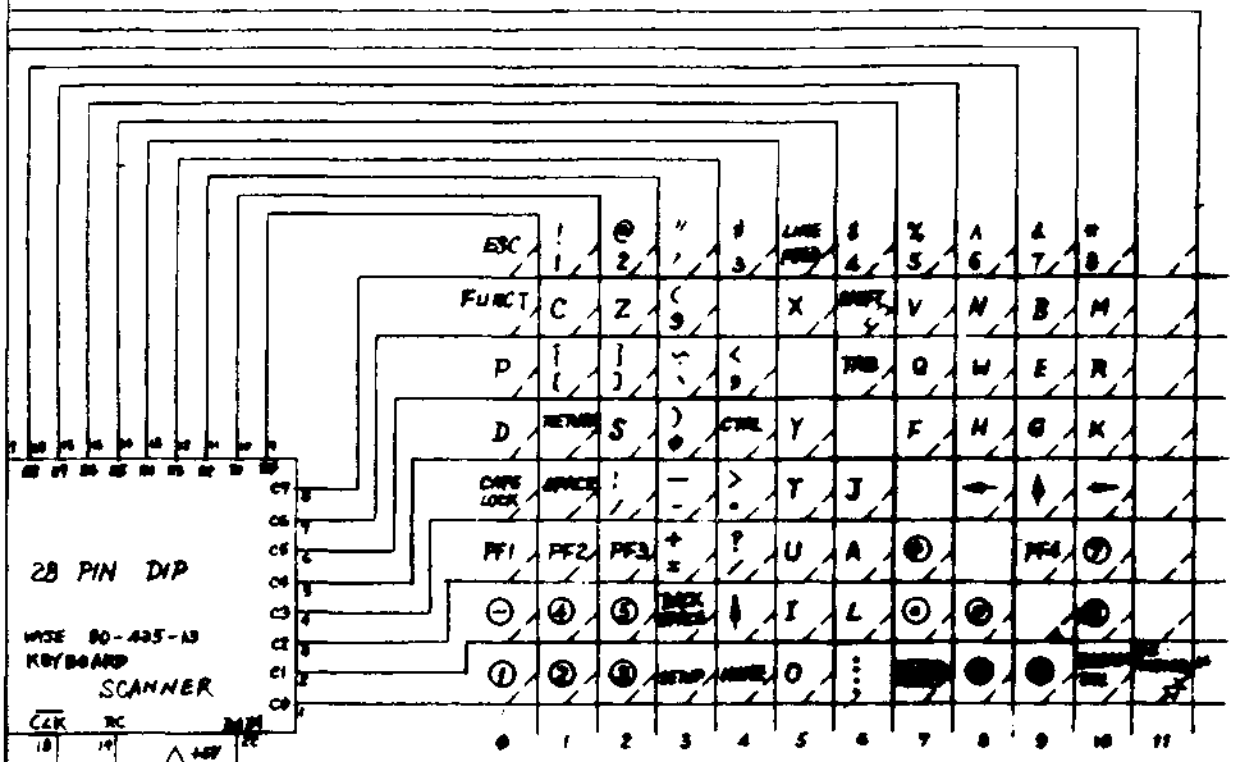

This chapter contains schematic diagrams for the terminal's keyboard PCB and terminal PCB to help you troubleshoot the terminal.

Figure 7-1 Keyboard PCB Schematic



DWG. NO 960067-01

| REV | DES |
|---|---|
| A | RTC PER |
| B1 | ADD D6 P |




* NOTE: WY-50 KEYB(

NOTE: CIRCLED KEYS ARE ON NUMERIC PAD

| QTY REQD | FSCM NO | PART OR IDENTIFYING NO | NOMENCLATURE OR DESCRIPTION |
|---|---|---|---|

PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
.X
.XX

MATERIAL

FINISH

DO NOT SCALE DRAWING

| | |
|---|---|
| | |
| 980067-01 | WY-30 K |
| NEXT ASSY | USED ON |

APPLICATION

WY-30 K

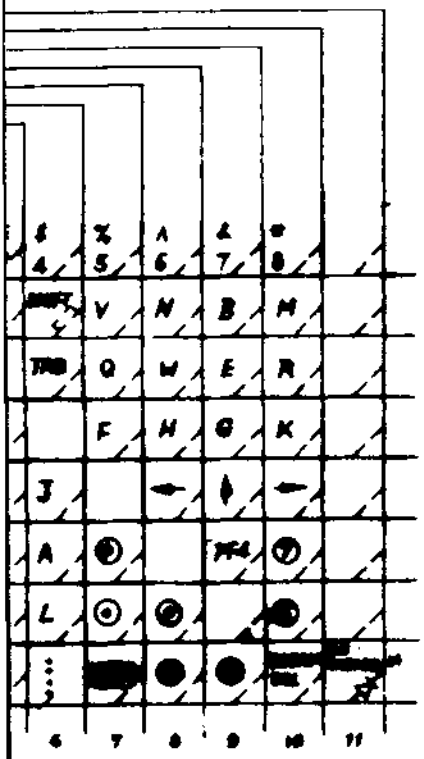
SIZE B FSCM NO

SCALE

DWG. NO. 960067-01 SH. 1 REV B1

REVISIONS

| REV | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
| A | RTC PER ECN# 822 | 6-4-85 | Cole |
| | | 7-10-85 | K R [illegible] |
| B1 | ADD D6 PER ECN 911 | 9-16-85 | [illegible] |




* NOTE: WY-50 KEYBOARD ID IS 01

RE ON NUMERIC PAD

| QTY REQD | FSCM NO | PART OR IDENTIFYING NO | NOMENCLATURE OR DESCRIPTION | MATERIAL SPECIFICATION |
|---|---|---|---|---|

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES X .XX

MATERIAL

FINISH

DO NOT SCALE DRAWING

WYSE TECHNOLOGY

WY-30 KEYBOARD SCHEMATIC

SIZE B | FSCM NO. | DWG. NO. 960067-01 | REV B1

SCALE | SHEET 1 OF 1

Figure 7-1 Keyboard PCB Schematic

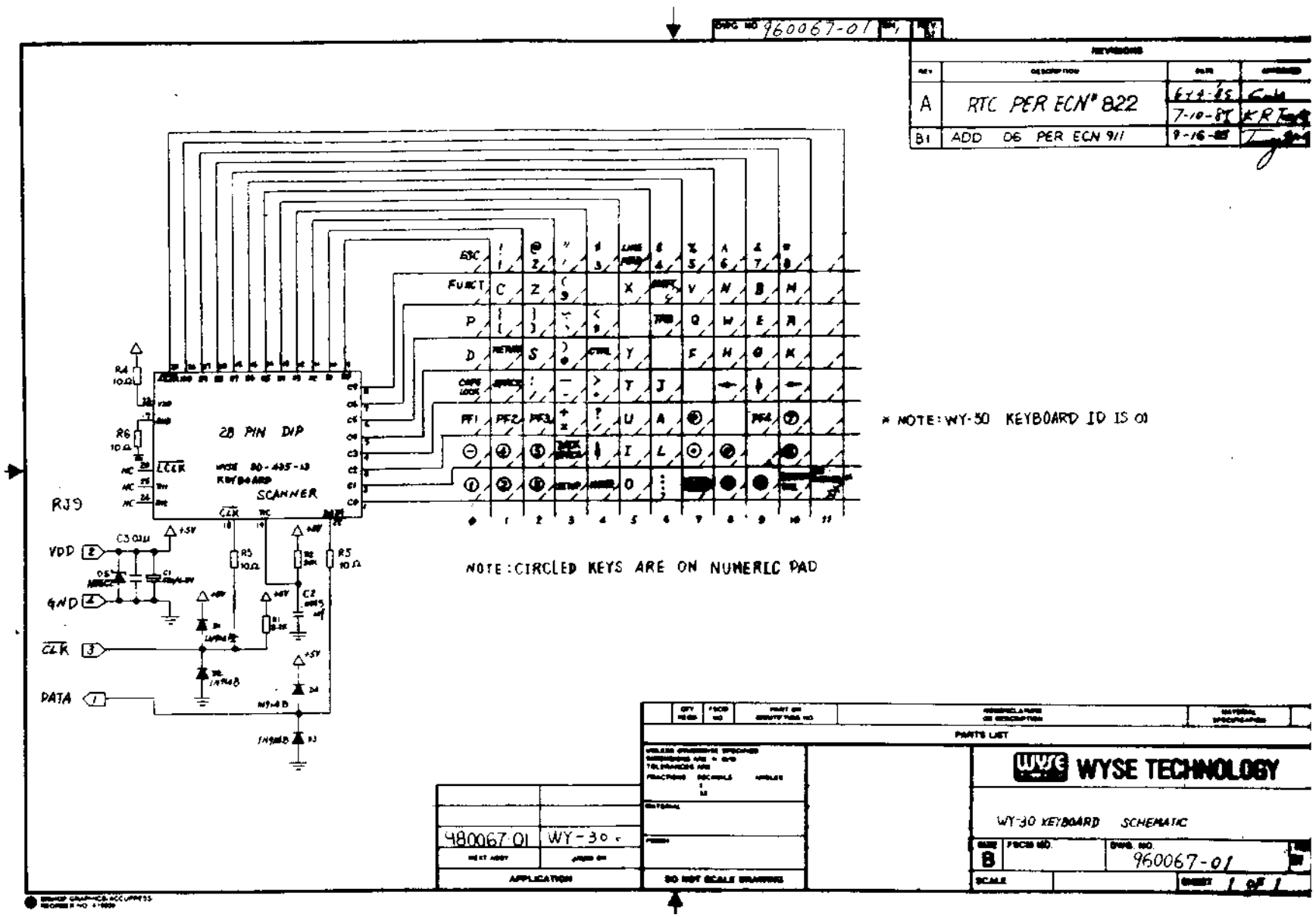
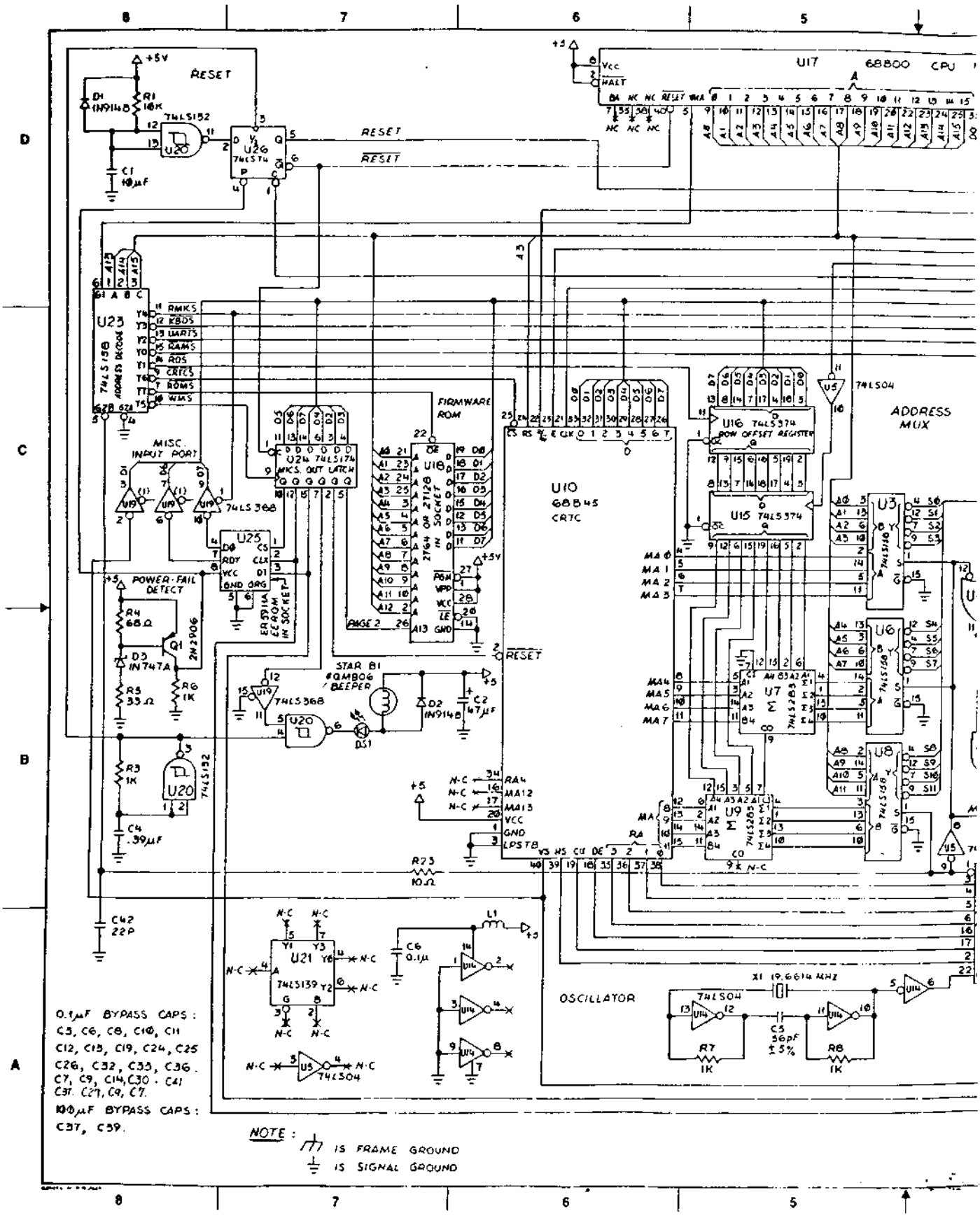
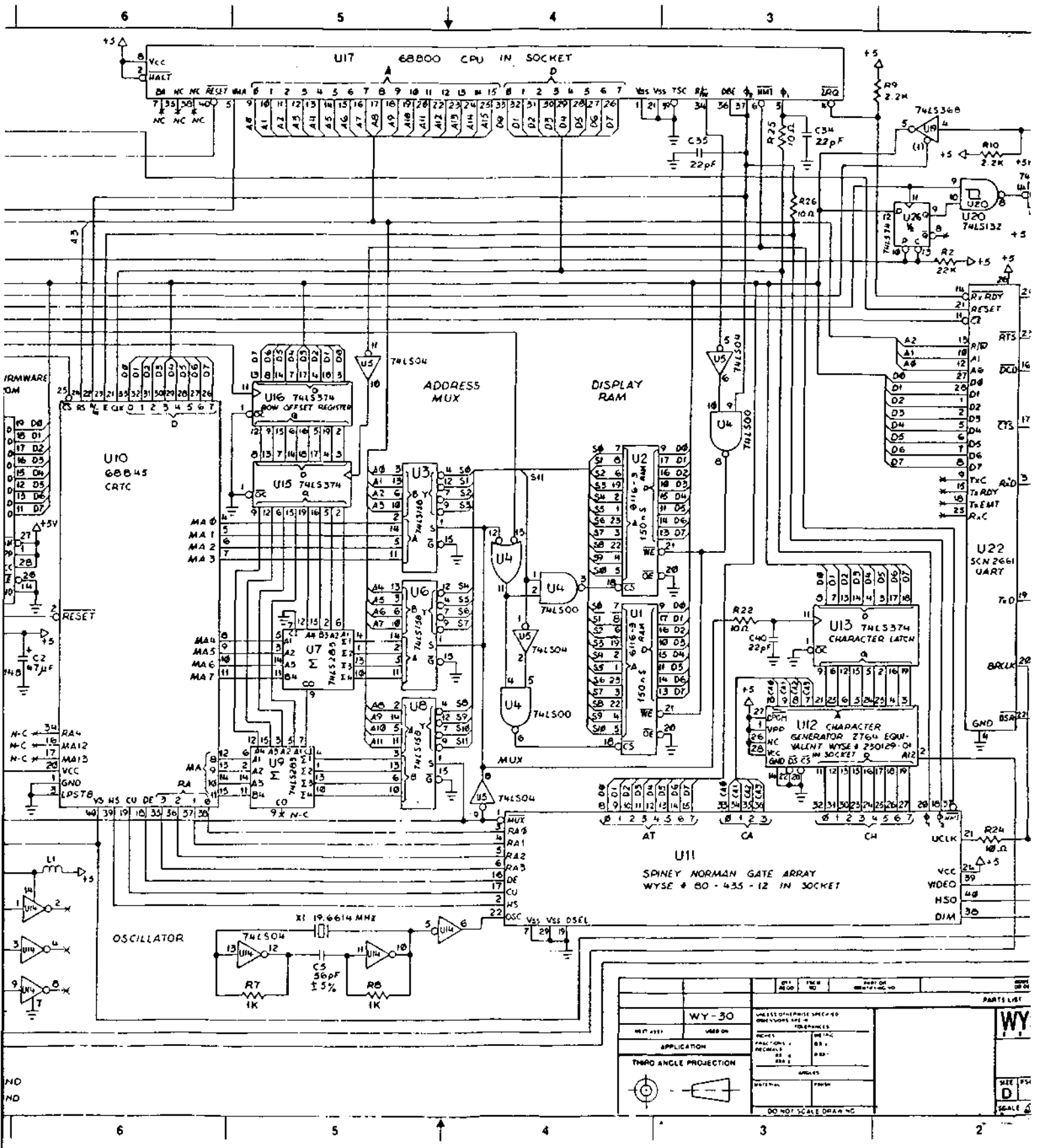


Figure 7-2 Terminal PCB Schematic (Logic)



ogic)


U17 68800 CPU IN SOCKET
U10 68845 CRTC
U16 74LS374 ROW OFFSET REGISTER
U15 74LS374
ADDRESS MUX
DISPLAY RAM
U2 6116-3 2K RAM 150nS
U1 6116-3 2K RAM 150nS
U3 74LS258
U6 74LS258
U8 74LS258
U7 74LS283 Σ
U9 74LS283 Σ
U4 74LS00
U5 74LS04
U13 74LS374 CHARACTER LATCH
U12 CHARACTER GENERATOR 2764 EQUIVALENT WYSE # 250129-04 IN SOCKET
U22 SCN 2661 UART
U20 74LS132
U11 SPINEY NORMAN GATE ARRAY WYSE # 60-435-12 IN SOCKET
AT
CA
CH
MUX
OSCILLATOR
X1 19.6614 MHz
C5 56pF ±5%
R7 1K
R8 1K
C34 22pF
C35 22pF
C40 22pF
C2 47µF
R9 2.2K
R10 2.2K
R2 22K
R22 10Ω
R24 10Ω
R25 10Ω
R26 10Ω
WY-30
APPLICATION
THIRD ANGLE PROJECTION
PARTS LIST
DO NOT SCALE DRAWING

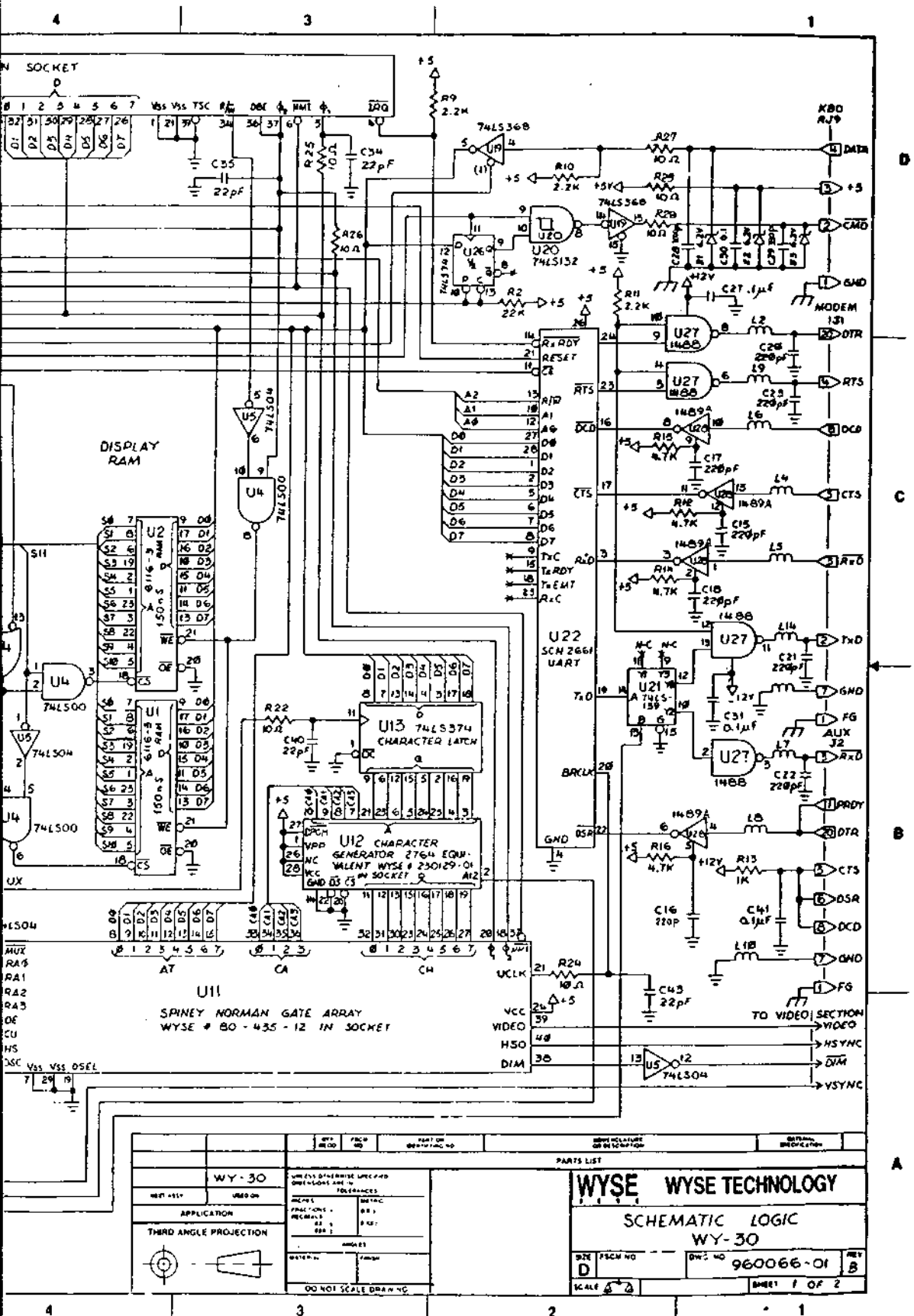

DISPLAY RAM
U22 SCN 2661 UART
U11 SPINEY NORMAN GATE ARRAY WYSE # 80-435-12 IN SOCKET
U12 CHARACTER GENERATOR 2764 EQUIVALENT WYSE # 250129-01 IN SOCKET
U13 74LS374 CHARACTER LATCH
74LS368
74LS138
74LS32
74LS04
74LS00
1488
1489A
KBD RJ9
MODEM J31
AUX J2
TO VIDEO SECTION
DATA
CMD
GND
DTR
RTS
DCD
CTS
RxD
TxD
RRDY
DSR
FG
VIDEO
HSYNC
DIM
VSYNC

Figure 7-2 Terminal PCB Schematic (Logic)

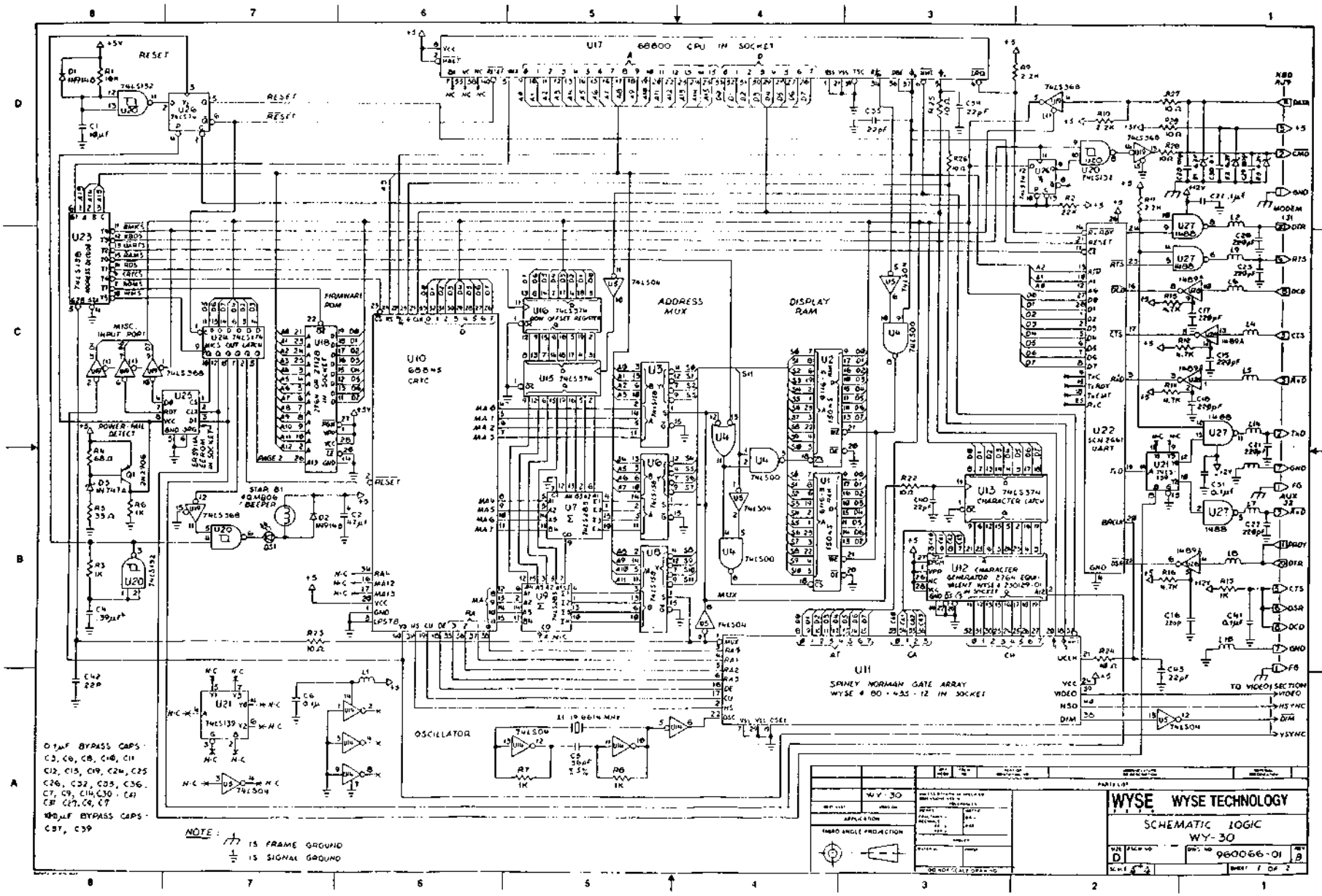
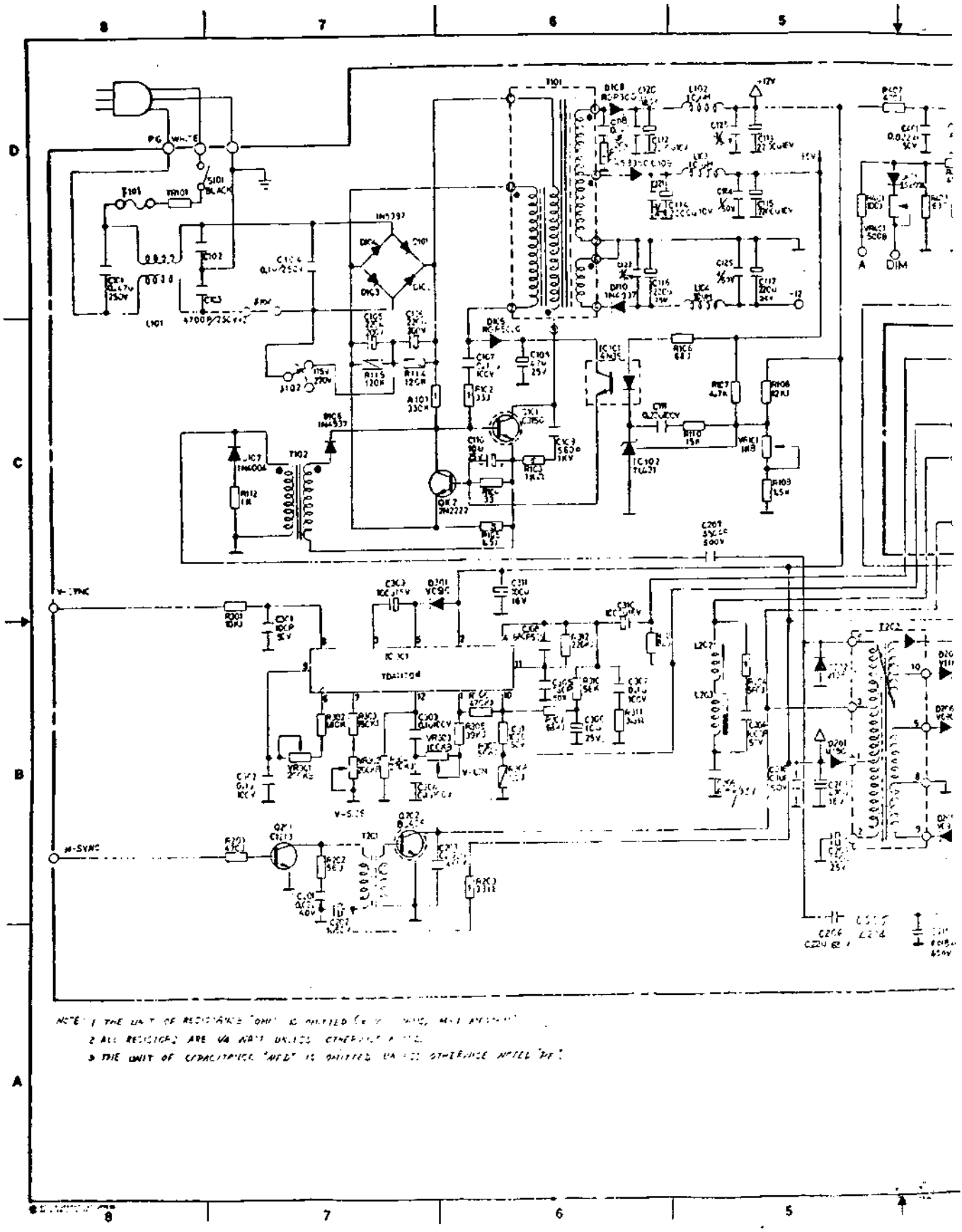
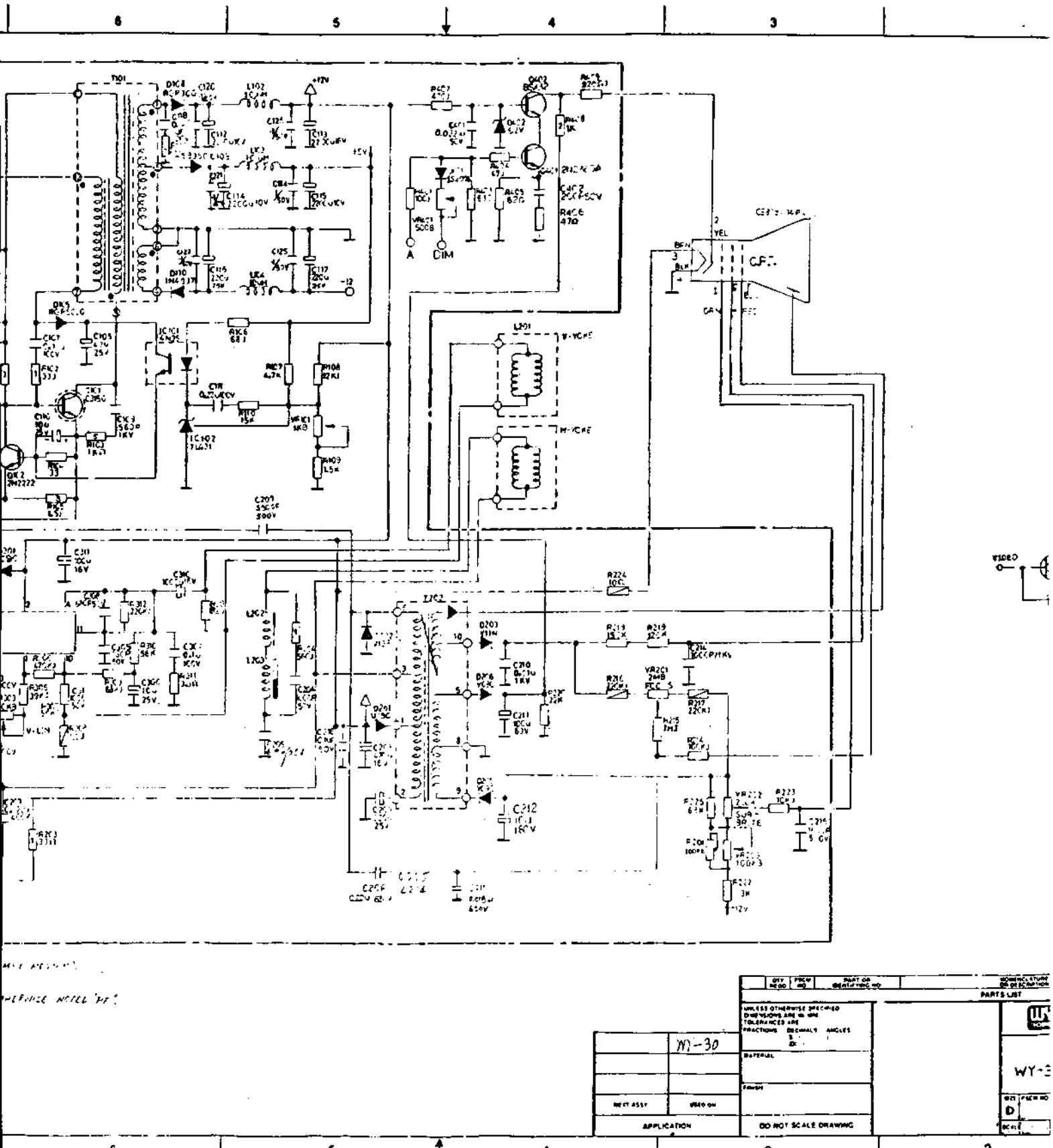


Figure 7-3 Terminal PCB Schematic (Monitor/Power Supply)



Monitor/Power Supply)



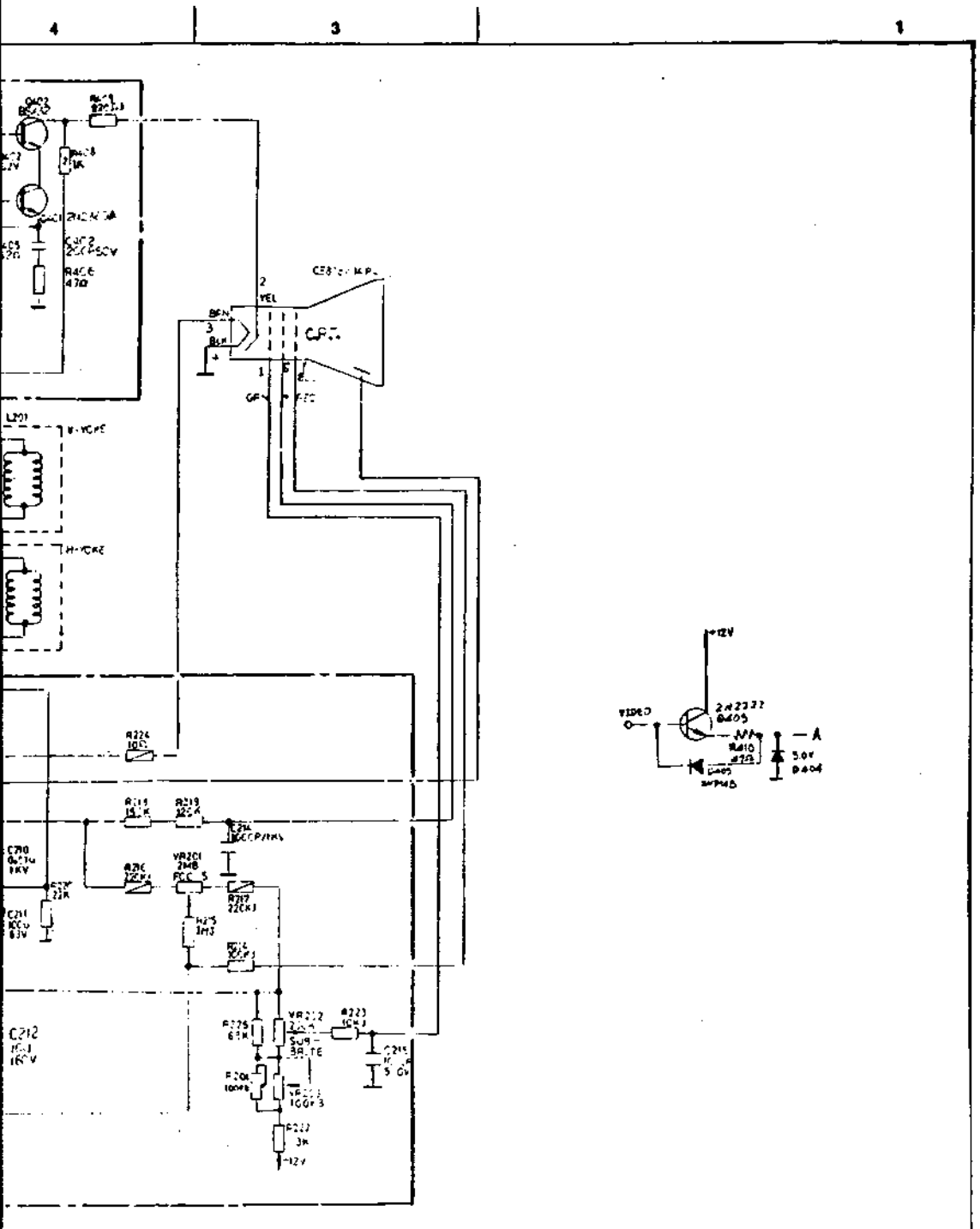
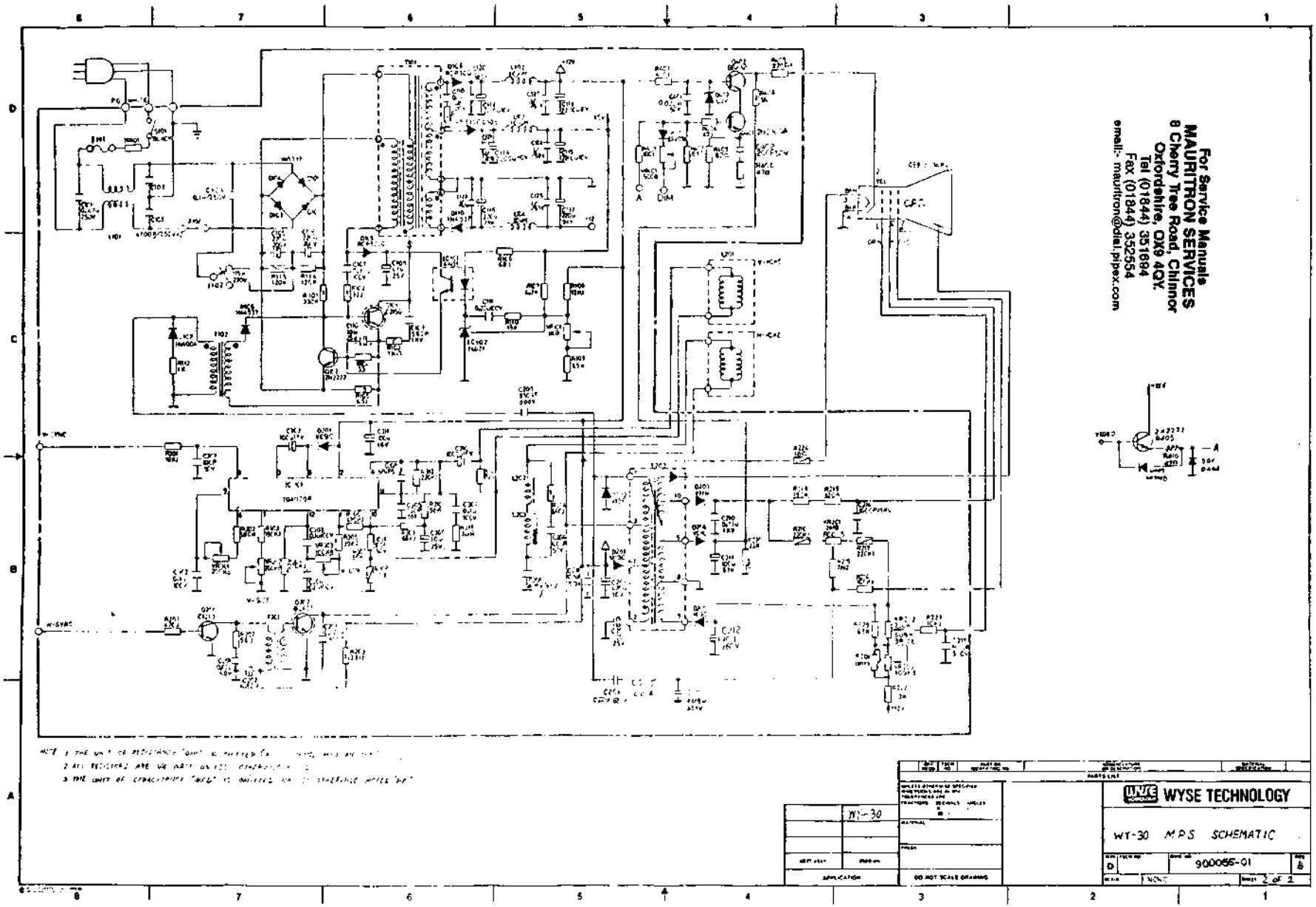

4
3
1
CRT
+12V
VIDEO
2N2222
Q405
-A
5.6V
D404
PARTS LIST
WY-30
APPLICATION
DO NOT SCALE DRAWING
WYSE TECHNOLOGY
WY-30 M.P.S SCHEMATIC
900065-01
D
B
NONE
SHEET 2 OF 2
4
3
2
1

Figure 7-3 Terminal PCB Schematic (Monitor/Power Supply)



# APPENDIX A SPECIFICATIONS

## Power Requirements

| | |
|---|---|
| Line voltage | 115/230 VAC |
| Line frequency | 47 to 63 Hz |
| Power consumption | 42 watts |
| Fuse | 125V, 2.0 ampere fast blow |

## Operating Requirments

| | |
|---|---|
| Ambient air temperature | +10 to +40 degrees Centigrade |
| Nonoperating air temperature | -40 to +60 degrees Centigrade |
| Operating altitude | 10,000 feet, ASL |
| Nonoperating altitude | 40,000 feet, ASL |
| Environmental humidity | 20 to 80%, noncondensing |

## Scan Frequency

| | |
|---|---|
| Horizontal | 19.858 to 19.862 kHz<br>19.860 kHz, nominal |
| Vertical | 59.994 to 60.006 Hz<br>60.000 Hz, nominal |

## Display Time

| | |
|---|---|
| Horizontal | 40.48 to 40.88 us |
| Vertical | 40.68 ms |

## Resolution

| | |
|---|---|
| Horizontal | 800 dots |
| Vertical | 312 lines |

## Display Format

| | |
|---|---|
| Horizontal | 80 columns |
| Vertical | 26 rows |

## Font Density

| | |
|---|---|
| Horizontal | 7 dots |
| Vertical | 10 dots |

## Character Cell

| | |
|---|---|
| Horizontal | 10 pixels |
| Vertical | 12 pixels |

**Retrace Time**

| | |
|---|---|
| Horizontal | 7.002 us (max) |
| Vertical | 0.400 ms (max) |

**Display Size**

| | |
|---|---|
| Horizontal | 237 mm, ±2.37 mm |
| Vertical | 172 mm, ±2.37 mm |

**Display Intensity, Nominal**

| | |
|---|---|
| Full bright | 50 fL, ±8 fL |
| Dim | 17 fL, ±8 fL |

**Focus** 50%

**Linearity**

| | |
|---|---|
| Horizontal | 12% |
| Vertical | 12% |

**Centering**

| | |
|---|---|
| Margin tolerance | ±4.00 mm |
| Pincushion and tilt | ±1.185 mm |

**Measurement Direction** Neck north

**Warmup Time** 30 minutes

**FCC Regulations**

Meets FCC rules and regulations, Part 15, Subpart J, Class A

**Regulatory Agencies**

UL 478 and CSA C22.2, no. 154 approved

**Dimensions**

| | |
|---|---|
| Terminal | 11.5"H x 12.5"W x 13"D (29cm x 32.cm x 33.5cm) |
| Screen | 14" (diagonal) (35cm) |
| Keyboard | 2.2"H x 16.4"W x 5.5"D (5.5cm x 42cm x 14cm) |
| Shipping Weight | 19 lbs. (8.6 kg) |

**Movement** Tilt and swivel

**Phosphor** P31 green

| | |
|---|---|
| **Synchronization** | TTL levels |
| **Video Attributes** | Dim, blink, blank, underline, reverse, protect, and combinations |
| **Cursor Attributes** | Block, underline, with or without blinking |

# APPENDIX B CONNECTOR PIN ASSIGNMENTS

The MODEM and AUX port connector pin assignments are listed below.

**Table B-1 MODEM Port Pin Assignments (DTE)**

| Pin | Signal |
|---|---|
| 1 | Shield ground |
| 2 | Transmit data (output) |
| 3 | Receive data (input) |
| 4 | Request to send (output) |
| 5 | Clear to send (input) |
| 7 | Signal ground |
| 8 | Data carrier detect (input) |
| 20 | Data terminal ready (output) |

**Table B-2 AUX Port Pin Assignments (DTE)**

| Pin | Signal |
|---|---|
| 1 | Frame ground |
| 3 | Transmit data (output) |
| 5 | Clear to send (output) |
| 6 | Data set ready (output) |
| 7 | Signal ground |
| 8 | Data carrier detect (output) |
| 11 | Printer ready (input) |
| 20 | Data terminal ready (input) |

# APPENDIX C TEST CONNECTORS

This appendix describes connections, signals connected, and the connector hood types needed for making the test connectors referenced in Chapters 3 and 4. If you prefer, you can order sets of them. See Chapter 5.

## MODEM PORT

Use a male DB-25 pin connector. Connect these pins (signals):

Pin 2 to Pin 3 (TxD to RxD)

Pin 4 to Pin 5 (RTS to CTS)

Pin 20 to Pin 8 (DTR to DCR)

## AUX PORT

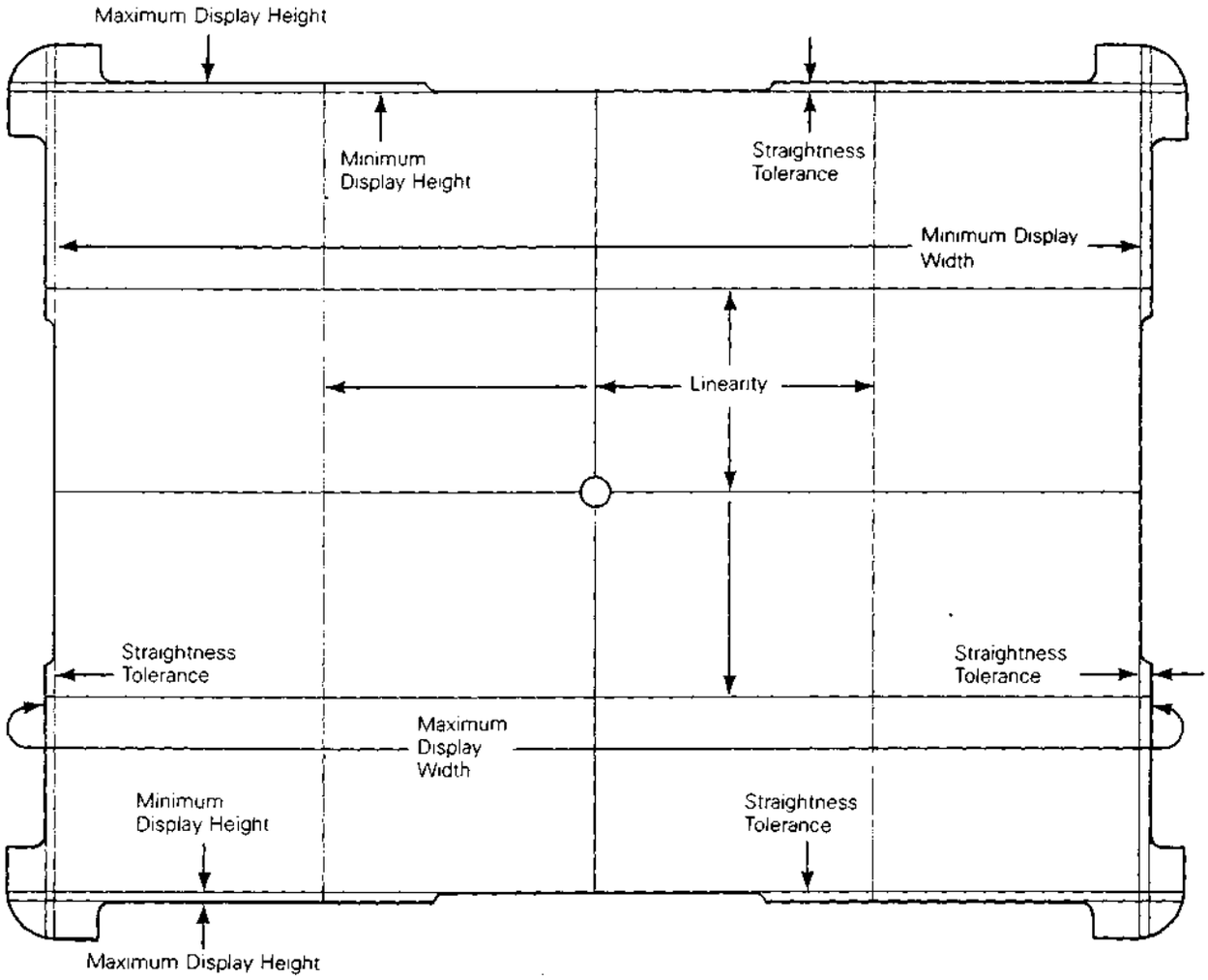
Use a male DB-25 pin connector. Connect these pins (signals):

Pin 3 to Pin 20 (RxD to DTR)

## APPENDIX D DISPLAY INSPECTION WITH THE RETICLE

The video inspection reticle, a sheet of milled plastic with markings, helps you measure the 14-inch monochrome display to determine whether or not the display is within specification. Figure D-1 shows the reticle and its markings.

**Figure D-1 Video Inspection Reticle**



## DEFINITIONS

Before checking the display, make sure you understand these terms:

| | |
|---|---|
| Bezel | The front-piece of the display case that frames the face of the CRT. |
| Display | The portion of the screen where the video display alignment pattern appears. |
| Linearity | A comparison of character height and width ranges in the display. You can check both vertical and horizontal linearity by comparing character height and width within the display. True linearity results in characters that are the same height and width range everywhere. See Appendix A for linearity tolerances. |
| Pincushion and Barrel Distortion | Distortion that results if deflection is not uniform at the raster edges when compared with the center of the display. Scan lines bowed inward are called **pincushion distortion.** Scan lines bowed outward are called **barrel distortion.** |
| Video Display Alignment Pattern | A test pattern to measure display alignment. |

## BEFORE YOU START

Before you check the alignment, do the following:

1. Turn on the terminal at least 30 minutes before you check the display. This warm-up period settles the display and gives you an accurate test pattern to measure.

2. Generate the terminal test pattern (as discussed in Chapter 4).

3. Point the neck of the CRT toward magnetic north to minimize the effects of the earth's magnetic field.

4. Have the video display reticle on hand to inspect the display.

## CHECKING THE DISPLAY WITH THE RETICLE

### Checking Width

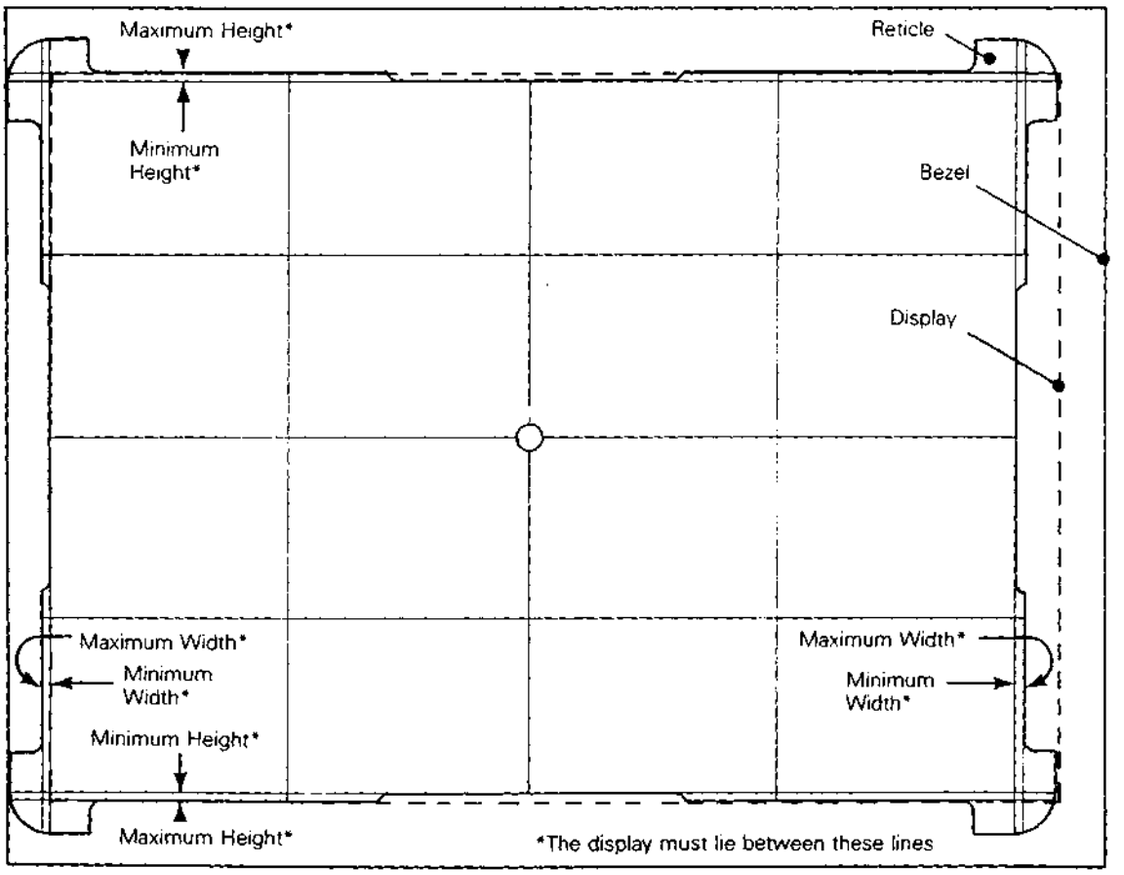
To check the display's width, follow these steps:

1. Rest the reticle along the lower horizontal edge of the bezel.

2. Check the left vertical edge, then the right vertical edge, of the alignment pattern by moving the reticle along the edge of the bezel. Both edges should fall between the minimum and maximum display width bands on the reticle (see Figure D-2).

3. If either edge falls outside the bands, adjust the display (see the alignment instructions in Chapter 4).

**Figure D-2 Checking Width and Height**



### Checking Height

To check the display height, follow these steps:

1. Rest the reticle on the left vertical edge of the bezel.

2. Move the reticle up and down along the edge. Check the top edge, then the bottom edge, of the alignment pattern. Both edges should fall between the minimum and maximum display height bands on the reticle (see Figure D-2).

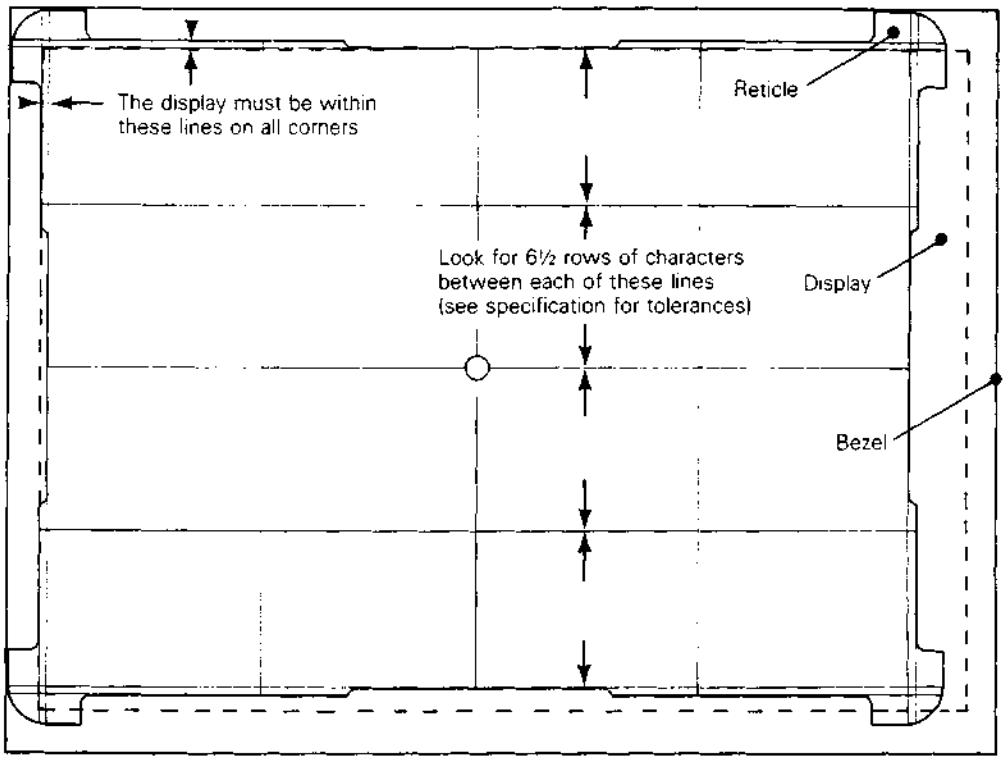
3. If one or the other edge falls outside the bands, adjust the display (see the alignment instructions in Chapter 4).

### Checking Straightness and Pincushioning

To check straightness and pincushioning, follow these steps:

1. Move the reticle along a horizontal edge of the bezel. Check the right vertical edge, then the left vertical edge, against the straightness lines etched on the perimeter of the reticle (see Figure D-3).

**Figure D-3 Checking Straightness, Pincushioning, Centering, and Vertical Linearity**



2. Move the reticle along a vertical edge of the bezel. Check the top edge, then the bottom edge, against the straightness lines etched on the perimeter of the reticle.

3. Position the upper right corner of the display between the etched markings on the upper right corner of the reticle. The display corner edge should fall within the scribed markings on the corner of the reticle.

4. Repeat the same procedure for the other corners of the display.

5. If an edge or corner doesn't fall within the markings, adjust the display (see Chapter 4).

**Checking Centering**

To check the centering follow these steps:

1. Hold the reticle over the center of the alignment pattern.

2. Move the reticle against the right edge of the bezel, then the left edge of the bezel. If the right and the left edges of the alignment pattern are inside the etched lines on the left and right sides of the reticle, the display is horizontally centered (see Figure D-3).

3. If the alignment pattern on the display isn't horizontally centered, adjust the display (see the instructions in Chapter 4).

4. Move the reticle against the top bezel edge, then the bottom bezel edge. If the top and the bottom edges of the alignment pattern are inside the etched lines on the top and bottom sides of the reticle, the display is vertically centered.

5. If the alignment pattern on the display isn't vertically centered, adjust the display (see Chapter 4).

**Checking Vertical Linearity**

To check vertical linearity, follow these steps:

1. Place the right side of the reticle against the right edge of the bezel (see Figure D-3).

2. Count the number of rows between each etched line on the reticle. The numbers should be within $\pm$15 percent of each other (90 percent of one line).

3. If numbers of rows between each line etched on the reticel aren't equal, adjust the display.

# INDEX


**A**

Adjustments
- centering rings, 4-12
- display leveling, 4-9
- display magnets, 4-11
- focus, 4-9
- height, 4-7
- linearity, 4-8
- power, 4-3
- sub-brightness, 4-8
- terminal display, 4-6
- vertical hold, 4-7
- width, 4-9

Alignment
- display, 4-6
- safety warning, 4-2

Anode discharging, 2-13

Attributes
- assignments, 6-7
- character, 6-6
- cursor, A-3
- screen, 6-7

AUX port
- definition, 6-12
- pin assignments, B-1
- test connector, C-1

**B**

Barrel distortion, D-2

Baud rate, 6-12

Bezel, D-2

Bit, 6-12

Brightness
- alignment, 4-8
- slideswitch, 1-6
- theory of operation, 6-11

Byte, 6-12

**C**

Capacitors, 5-7

Cathode ray tube (see CRT)

Centering
- checking with reticle, D-5
- rings, 4-12
- specifications, A-2

Central processing unit (see CPU)

Character
- attributes, 6-6, 6-7
- cell, A-1

Circuit isolation jumpers, 3-13

Circuit protection, 6-10

Cleaning, 1-7

Coils, 5-6

Communication cable installation, 1-6

Communication ports, 6-12

Component diagram
- power supply, 4-3
- terminal PCB, 5-9

Components list
- capacitors, 5-7
- coils, 5-6
- crystals, 5-6
- diodes, 5-6
- integrated circuits, 5-5
- keyboard, 5-8
- resistors, 5-5
- transformers, 5-8
- transistors, 5-6

Computer interface, 3-9

Continuity check, 3-9

CPU definition, 6-12

CRT
- definition, 6-12
- display, 1-3

CRT/yoke assembly
- removing, 2-10
- replacing, 2-11

CRTC
- definition, 6-13
- values, 6-6

Crystals, 5-6

Cursor attributes, A-3

**D**

Diagnostic self-test
- connectors, 5-10
- error messages, 3-12
- procedure, 3-11

Dimensions
- keyboard, A-2
- terminal, A-2

Diodes, 5-6
Discharging the anode, 2-13
Display
  adjustments, 4-7
  alignment, 4-6
  capacity, 1-3
  check with reticle, D-3
  circuitry, 6-10
  definition, D-2
  format, A-1
  intensity, A-2
  leveling adjustment, 4-9
  margins, 4-5
  monitor circuitry, 6-10
  problems, 4-7
  size, A-2
  specification, 4-4
  time, A-1
Display magnets, 4-11

E
EAROM definition, 6-13
Environment, 1-4, 3-8
Environmental considerations
  air flow, 1-4
  temperature, 1-4
Error messages
  diagnostic self-test, 3-12
  power-on self-test, 3-11
Exploded view
  keyboard assembly, 5-4
  terminal display assembly, 5-3

F
Flowchart for
  troubleshooting, 3-3
Flyback transformer, 6-11
Focus
  adjustment, 4-9
  specification, A-2
  theory of operation, 6-11
Font density, A-1
Frequency, A-1
Fuse
  removal/replacement, 2-7
  specifications, A-1

H
Height
  adjustment, 4-7
  checking with reticle, D-4
Horizontal deflection, 6-10
Horizontal font density, A-1

I
I/O (see Input/Output)
Input/Output
  definition, 6-13
  devices, 1-2
Installation
  communication cable, 1-6
  keyboard, 1-5
  power cord, 1-6
  terminal, 1-4
  terminal checklist, 3-8
Integrated circuits, 5-5
Interfaces
  asynchronous, 1-3
  modem, 1-3
  operator, 1-5
  primary, 1-3
  RS-232C, 1-3
  video, 6-4
Interrupts, video, 6-6
Isolating circuits, 3-13

K
Keyboard
  assembly components list, 5-4
  checking, 3-12
  description, 1-3
  installation, 1-5
  PCB, 2-5
  removal/replacement, 2-3
  schematic, 7-3
  theory of operation, 6-11
Keyboard cable
  removal/replacement, 2-4
  replacement, 2-4

L
Linearity
  adjustment, 4-8
  checking with reticle, D-5
  definition, D-2
  horizontal, A-2
  modulating coil, 6-11
  vertical, A-2
Logic, 6-2, 7-5

M
Measurement direction, A-2
Memory
  limitations, 6-2
  map, 6-3
  terminal, 1-2
Microcomputer
  definition, 1-2

Microcomputer (continued)
input/output, 6-8
theory of operation, 6-2
MODEM port
definition, 6-13
pin assignments, B-1
test connector, C-1
MUX, 6-13

O
Operating requirements, A-1
Operator interfaces
brightness slideswitch, 1-6
communication cable, 1-6
keyboard, 1-5
power cord, 1-6
power switch, 1-6
setup parameters, 1-6
touch/tilt screen adjustment, 1-6

P
Parameters
CRT controller, 6-5
setup, 1-6
Parts, 5-2
Pin assignments
AUX port, B-1
MODEM port, B-1
Pincushion
check with reticle, D-4
definition, D-2
Pixel, 6-13
Power cord
installation, 1-6
installation checklist, 3-8
Power on self-test
description, 3-10
error messages, 3-11
Power requirements, A-1
Power supply
adjusting, 4-3
adjustments, 4-3
theory of operation, 6-9
voltage check, 3-9
Power switch, 1-6

R
RAM definition, 6-13
Removal and replacement
modules, 2-2
Removing
assemblies in the terminal module, 2-5
CRT/yoke assembly, 2-10
terminal enclosure, 2-6
terminal PCB, 2-8
the keyboard, 2-3
the keyboard cable, 2-4
the keyboard PCB, 2-5
yoke, 2-12
Replacing
CRT/yoke assembly, 2-11
fuse, 2-7
terminal enclosure, 2-13
terminal PCB, 2-10
yoke, 2-12
Requirements
operating, A-1
power, A-1
Resistors, 5-5
Resolution, A-1
Reticle
checking centering, D-5
checking height, D-4
checking linearity, D-5
checking pincushioning, D-4
checking straightness, D-4
checking width, D-3
Retrace time, A-2
ROM definition, 6-13

S
Safety warnings, 2-2, 3-2, 4-2
Scan frequency, A-1
Schematics
keyboard, 7-3
terminal PCB (logic), 7-5
terminal PCB (monitor/power supply), 7-7
Screen
aligning the display, 4-6
dimensions, A-2
touch/tilt adjustment, 1-6
Self-test
diagnostic, 3-11
power-on, 3-10
Setup parameters, 1-6
Shipping weight, A-2
Spare parts, 5-2
Specifications, A-1
Straightness check, D-4
Sub-brightness adjustment, 4-8

T
Terminal
  aligning the display, 4-6
  cleaning, 1-7
  clearances, 1-4
  control, 1-2
  description, 1-2
  dimensions, 1-4
  display assembly list, 5-3
  installation, 1-4
  installation checklist, 3-8
  logic, 6-2
  preparation for reticle procedure, D-2
  specifications, A-1
Terminal enclosure
  removal, 2-6
  replacing, 2-13
Terminal PCB
  component layout diagram, 5-9
  removing, 2-8
  replacing, 2-10
  schematic, 7-5, 7-7
Test connector
  AUX port, C-1
  MODEM port, C-1
Theory of operation
  brightness, 6-11
  circuit protection, 6-10
  communication ports, 6-12
  display monitor circuitry, 6-10
  flyback transformer, 6-11
  focus, 6-11
  focus and brightness circuits, 6-11
  horizontal deflection, 6-10
  keyboard, 6-11
  linearity modulating coil, 6-11
  microcomputer, 6-2
  power supply and monitor circuitry, 6-9
  vertical deflection, 6-10
  vertical size, 6-10
  video amplification, 6-11
Tools required
  alignment, 4-2
  power supply check, 3-9
  removal or replacement of assemblies, 2-3
Touch/tilt screen
  adjustment, 1-6
Transformers, 5-8
Transistors, 5-6
Troubleshooting
  aids, 3-8
  flowchart, 3-3
  quick reference guide, 3-3
  safety warning, 3-2
  symptoms, 3-3
  tools required, 3-2

U
UART definition, 6-13

V
Vertical
  deflection, 6-10
  hold adjustment, 4-7
Vertical font density, A-1
Video
  amplification, 6-11
  attributes, A-3
  character data, 6-7
  display alignment pattern, D-2
  inspection reticle, D-1
  interrupt, 6-6
  synchronization, 6-4
Voltages
  checking, 3-10
  power supply, 3-9
  specifications, A-1

W
Warmup time, A-2
Weight, A-2
Width
  adjustment, 4-9
  checking with reticle, D-3

Y
Yoke
  removing, 2-12
  replacing, 2-12
Yoke lock
  display leveling adjustment, 4-9
  saftey warning, 4-9